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A Naval Safety Center Publication

approach

OCTOBER 1971 THE NAVAL AVIATION SAFETY REVIEW

Wheels-Up Landings

ON PURPOSE

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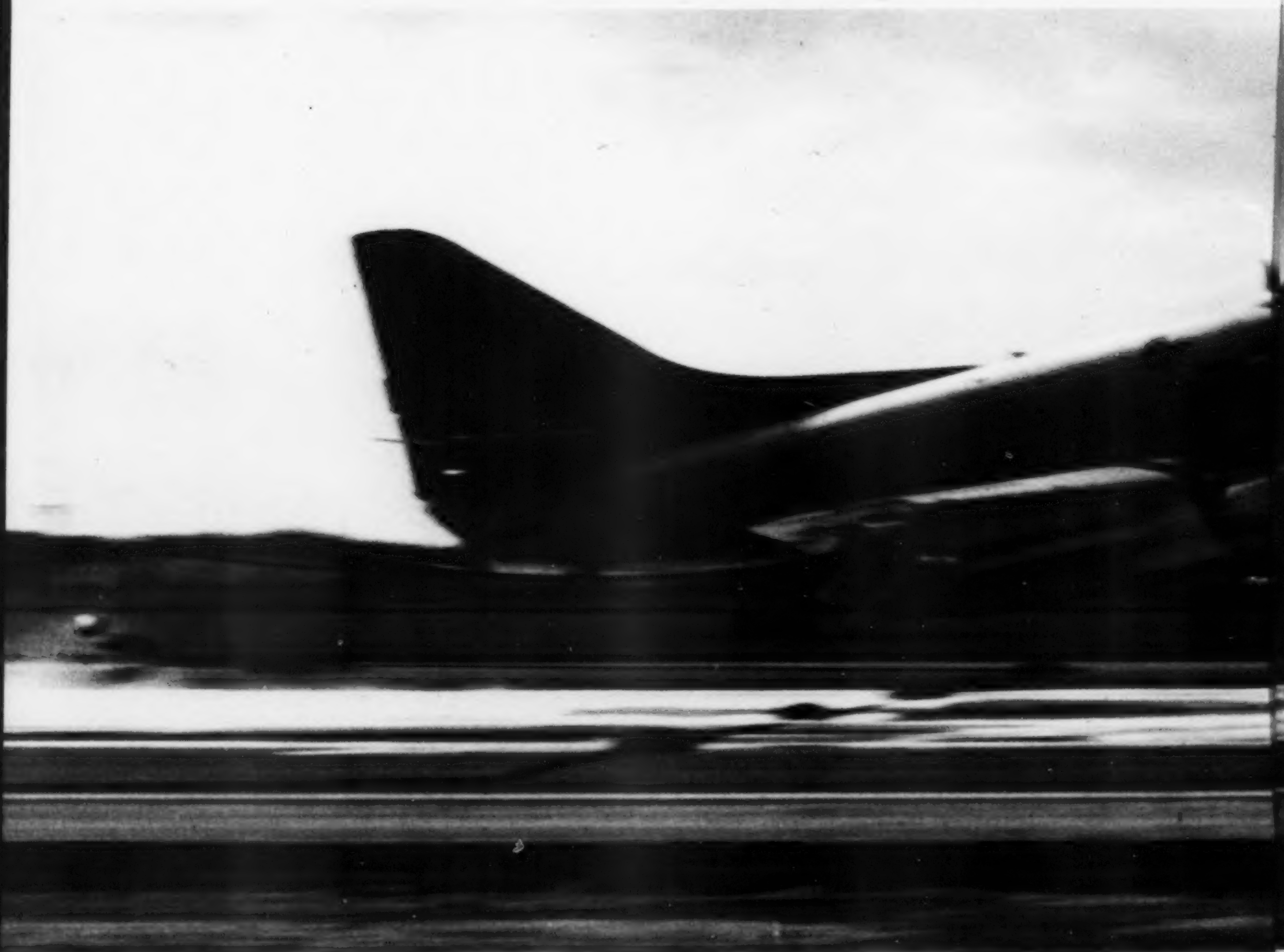


Fixed-Wing Aircraft FY

E

FROM time to time, pilots of Navy aircraft find they are unable to lower all landing gear to the proper configuration for landing. This creates an emergency situation in any aircraft, but especially in those which have a limited fuel reserve. If the landing gear cannot be lowered by emergency procedures, the pilot is faced with the decision to land the aircraft with one or more landing gear up or eject/bailout.

The question always arises – can the aircraft be landed safely? Should arresting gear be used? Should the runway be foamed? Is an LSO required on station – etc? The answers to these questions depend upon the specific situation. NATOPS provides the best guidance for pilots faced with landing gear malfunctions, and nothing stated herein should be interpreted as superseding established NATOPS procedures. Nevertheless, we believe pilots and operations personnel are always interested in hearing the experiences of others who have faced certain problems. Moreover, knowledge of the type of malfunctions experienced may prove valuable to maintenance personnel in preventing similar incidents in the future.

Continued

raft FY-67 through 71

INTENTIONAL (EMERGENCY) WHEELS-UP LANDINGS

Fixed-Wing Aircraft FY-67 thru 71

AIRCRAFT	LANDING CONFIGURATION	NUMBER LANDINGS	AIRCRAFT DAMAGE				ARRESTING GEAR USED	FOAM USED
			Destroyed	Substantial	Minor	Limited		
A-3	Nose Landing Gear – UP*	1			1		1	1
	All – UP	2		2			2	1
A-4	Nose Landing Gear – UP	4			1	3	1	3
	All – UP	32		1	7	24	13	24
A-5	Nose Landing Gear – UP	3			1	2		
A-6	Nose Landing Gear – UP	1		1			1	1
	Both MLG – UP; NLG – DN	1		1			1	1
	One MLG – UP	12		1	4	7	10	10
A-7	Nose Landing Gear – UP	26		2	24			5
	NLG – UP; One MLG – UP	1		1			1	
	One MLG – UP	1			1			1
	All – UP	2		2				2
C-1A	Nose Landing Gear – UP	3				1		3
	All – UP	4		1	3			4
C-2A	One MLG – UP	1				1		1
E-1B	Nose Landing Gear – UP	1				1		
	One MLG – UP	1		1			1	1
E-2	Nose Landing Gear – UP	3			2	1	1	1
	One MLG – UP	1			1			1
	All – UP	1			1		1	1
F-4	Nose Landing Gear – UP	2		1	1			1
	One MLG – UP	9			6	1	6	7
	All – UP	2		1	1		1	2
F-8	Nose Landing Gear – UP	9		3		6		
	One MLG – UP	6		2		4	3	2
	All – UP	1	1					1
F-9	Nose Landing Gear – UP	5				5		2
	One MLG – UP	9			1	8	4	2
	All – UP	2			2		2	2
S-2	Nose Landing Gear – UP	1				1		1
	One MLG – UP	1		1			1	
	All – UP	19		4	9	6	10	16
T-1A	Nose Landing Gear – UP	1	1					1
	All – UP	1		1				1
T-28	Nose Landing Gear – UP	1				1		
	One MLG – UP	1			1		1	1
	All – UP	6	1	1	3	1	1	1
T-34	Nose Landing Gear – UP	5			1	4		1
	All – UP	2			1	1		2

* The word "UP" on this chart indicates that the gear was actually UP – or that there was an unsafe indication for a gear which collapsed on touchdown. The remaining landing gear, unless otherwise indicated, were down and locked.

Chart 1

Past Experience

During the period FY-67 through 71, there were a total of 184 intentional landings on hard-surfaced runways with landing gear in some configuration other than the normal configuration. (See Chart 1.) This included landings with:

(1) Nose gear up (66).
(2) Nose gear and one main landing gear up (1).
(3) One main landing gear up (42).
(4) Both main landing gear up; nose gear down (1).
(5) All landing gear up (74).

(Note: There were 12 additional intentional wheels-up landings made by aircraft which are no longer in the Navy's inventory in substantial numbers, e.g., A-1 and F-11A. Statistics on these aircraft are not included in Chart 1.)

Chart 1 shows the number of landings for each series aircraft in each configuration. Also shown for each configuration is the damage incurred and the number of times arresting gear and foamed runways were used.

There were no fatalities involved in any of the 184 landings. Furthermore, there were only one major and two minor injuries. No one will deny that these statistics are encouraging, but they should not be cause for complacency. Statistics notwithstanding, landing an aircraft with a landing gear malfunction is a demanding job and a potential for injury always exists, however slight.

The aircraft, however, did not fare quite as well as the people. Three aircraft received strike damage; 27 substantial damage; 72 minor damage, 78 limited damage and four received no damage.

Causes of Landing Gear Malfunctions

Space does not permit an exhaustive analysis of *all* landing gear malfunctions, but a brief discussion of selected mishaps may be helpful.

A-4 Aircraft

A-4 landing gear malfunctions involved a wide variety of cause factors. However, the predominant factor was loss of pressure in MLG (main landing gear) struts. This was due to one or more of the following:

- Failure to service struts with proper nitrogen pressure.
- Incorrect installation of O-rings in Schrader valves.
- Leaking Schrader valves.
- Failure of strut packing.

Another leading cause of landing gear malfunctions was failure or malfunction of the catapult hook retract mechanism, caused either by material failure or maintenance error in adjustment. Other causes of A-4 landing gear malfunctions included:

- Failure of MLG wheel bearings.
- Disconnected hydraulic lines.
- Corrosion and/or lack of proper lubrication of landing gear components.
- Chafing of electrical actuating lines.

Continued

A-6 Aircraft

Most gear-up landings in A-6 aircraft involved some malfunction of main landing gear doors and included:

- Failure of MLG door timer valve or door lock valve.
- Misalignment of forward door latch roller/retainer.
- Misalignment of MLG or NLG (nose landing gear) actuating cylinder.
- MLG overcenter link/striker arm out of tolerance.
- Bleed air duct failure and subsequent damage to landing gear actuating components.
- Foreign object (jack pad) jammed MLG in up position.

Finally, in one case, maintenance personnel used a chock to hammer the latch closed on an engine bay door, bending the latch actuating rod. This door separated in flight, struck a MLG door and damaged it to the extent that the gear could not be lowered.

A-7 Aircraft

Most of the 30 A-7 landing gear malfunctions involved the nose landing gear. The predominant cause factor was failure of the PC-2 hydraulic system. Most of these PC-2 failures were attributed to material failures, e.g., hydraulic pump, aluminum fittings in hydraulic line and sticking vent or check valves. However, maintenance error was suspected in a few cases, i.e., overtorquing of fittings and seals and failure to properly service accumulators.

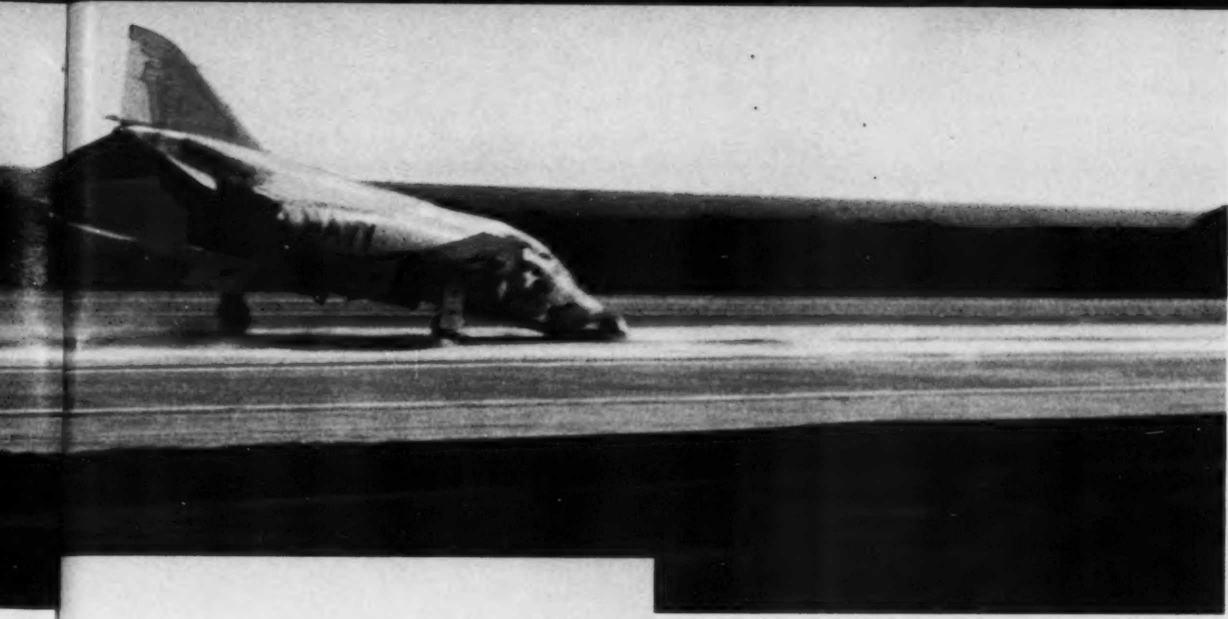
A PC-2 system failure does not necessarily mean a gear-up landing. The emergency landing gear extension system is designed to lower the gear when a PC-2 system failure occurs but failed to operate as designed in these cases because of:

- Binding of landing gear components due to corrosion and lack of lubrication or improper adjustment.
- Failure of maintenance personnel to properly service accumulators.
- Sticking check valves.
- Failure of O-ring seals.

Other cause factors in A-7 landing gear malfunctions (not involving PC-2 failures) included:

- Loss of nose landing gear cylinder and piston on CV catapult shot (two cases).
- Extension of NLG in flight due to:
  (1) Failure of uplatch assembly.
  (2) Inadvertent actuation in flight by pilot.
  (3) Misrigging of NLG door actuating rod causing insufficient overcenter travel of C-link.
- Failure of NLG steering bellcrank causing NLG to jam in trail position.

- Failure of maintenance personnel to install retainer washer on NLG actuating attaching bolt, allowing actuator rod end to slip off bushing and detach from upper drag link.
- Progressive cracks of NLG actuating cylinder rod end threaded area due to high-stress overload of thread root area.
- Failure of bolt assembly that retains NLG door shaft roller assemblies precluding actuation of NLG uplock mechanism.
- Binding of NLG door shaft assembly induced failure of NLG door actuating bellcrank (shaft assembly frozen apparently due to lack of lubrication).
- Failure of NLG door shaft arm assembly attaching bolts preventing NLG uplock J-hook release.
- Binding of NLG bellcrank assembly due to rust and corrosion. Lack of proper lubrication indicated.
- NLG upper door linkage out of rig.



F-4 Aircraft

Most F-4 mishaps involved landings with one MLG up. The major cause of landing gear malfunctions was material failure. There were six utility hydraulic system failures. In each of these cases, some other material failure prevented the emergency extension system from operating as designed. Specific material failures included:

- Failure of MLG shrink links.
- Failure of MLG shrink link induced by failure of MLG strut metering pin.
- MLG fork assembly failure on a bolter (caused by stress corrosion and hydrogen embrittlement).
- Failure of uplock shuttle valve due to improper internal clearances.
- Failure of hydraulic line at flare under B-nut fitting (suspect overtorquing).
- Leak of high-pressure nitrogen from lower chamber of MLG shock strut, allowing upper (low-pressure) chamber to be overpressurized.

The two mishaps directly attributed to maintenance error involved an uplock actuator which was installed incorrectly and the failure of an emergency pneumatic line caused by chafing due to incorrect installation.

F-8 Aircraft

Nose-landing-gear-up landings exceeded all other types of mishaps. One-main-gear-up landings were a close second. There were several utility hydraulic system failures. The emergency system did not function properly for one reason or another, including:

- Two cases where no attempt was made by the pilot to lower the gear by the emergency system. (In one case the pilot did not know where the control was located nor how to use it.)
- A crushed pneumatic line (caused by improper routing).
- Cap on pneumatic system drain line in nose wheelwell came off.

Other malfunctions (not involving utility hydraulic system failure) included:

- Hard CV landings, damaging landing gear (4 cases).
- IRS power supply in starboard MLG well came loose from bulkhead and jammed wheel.
- MLG door actuator support failed in flight

allowing doors to open and incur damage.

• Material failure of NLG actuator rod end at grease fitting (wrong type of grease fitting installed).

F-9 Aircraft

One-main-landing-gear-up landings predominated in F-9 mishaps. Two mishaps resulted from hard CV landings which damaged landing gear. Three mishaps resulted primarily from failures of student pilots to properly use the emergency landing gear extension system when faced with landing gear malfunctions. Two mishaps appeared to have been caused by inadequate lubrication/corrosion control which allowed landing gear components to bind. One mishap was due to failure to remove downlocks prior to flight. Specific material failures included:

• Hydraulic system failure due to failure of elbow fitting on starboard gun charger. Emergency system ineffective due to port MLG door control valve being installed with rotor 90 degrees out of phase.

• Rod end on port MLG uplock cylinder broke.

• NLG door actuator terminal rod end failed – doors would not open (metal fatigue).

• Port MLG uplock cylinder shaft failed (excessive loads).

• Material failure of connecting eye terminal to NLG actuator (metal fatigue).

S-2 Aircraft

Nineteen out of 21 wheels-up landings were all-gear-up. Landing gear malfunctions were primarily caused by material failures. The majority of these failures involved failure of MLG doors to open properly. This included failure of MLG door horn attach fittings, door hinges and MLG door timer check valves. However, at least two mishaps were caused by maintenance error. These included:

• An aircraft which was put up for flight with MLG doors removed and hydraulic lines capped off.

• J-hook actuating rod was disconnected during maintenance and was not reconnected prior to flight.

Summary

There have been a substantial number of intentional wheels-up landings during the last five years. Many of these were caused by material failures, but a substantial number involved maintenance factors.

It is difficult to suggest effective procedures to decrease landing gear malfunctions. It seems likely, however, that some mishaps can be prevented in the future by closer attention to landing gear maintenance. In particular, attention should be focused on:

• Insuring that both primary and emergency landing gear systems are functionally dropchecked when appropriate.

• Removal of all foreign objects from the area of landing gear operating mechanisms.

• Maintenance of catapult hook retracting mechanisms.

• Routing of air and hydraulic lines (to prevent chafing).

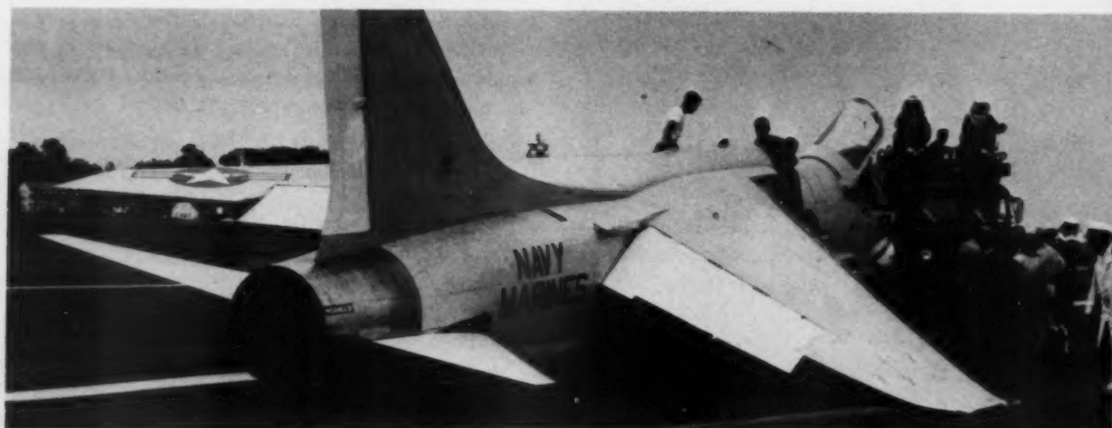
• Careful day-to-day maintenance of hydraulic systems. (Don't overtorque fittings.)

• Insuring landing gear components operate freely without binding.

• Proper servicing of accumulators.

• Proper lubrication and corrosion control procedures.

Fortunately, considering the potential hazards involved, aircraft damage and injuries caused by intentional wheels-up landings have been minimal. While this is undeniably good, it will be even better if we purposely prevent the landing gear malfunctions which lead to wheels-up landings – on purpose.



82 Percent Unintentional

JUST in case helicopter pilots wonder why nothing was said in the main article concerning helicopter wheels-up landings, it isn't that there were none; it is just that we thought we would give helicopters special attention. In the first place, most helicopters have fixed landing gear. Secondly, in those models with retractable landing gear, such as the H-2, H-3 and H-53, the number of maintenance errors or material failures totaled only four. There was only one accident in which damage occurred to the main landing gear before landing. So, out of a total of 28 wheels-up landings in five fiscal years, there were just five which were intentional. In four of these, support personnel were able to lower the gear manually while the pilot hovered the helicopter or kept the nose landing gear off the deck. *The other 23 accidents and incidents were unintentional.*

There was one encouraging aspect revealed in this study and that was the absence of any injuries as a result of wheels-up landings – even in the one accident involving strike damage. However, to forestall any smugness, recognize that in each case, disaster and injury or death to aircrews and support personnel was possible. The number of wheels-up landings by model/fiscal year is shown in Fig. 1. It is appropriate here to comment on the reason why the one UH-46A accident is listed in this study. The reason this fixed-gear helicopter is included is that during a night SAR mission the pilot inadvertently went IFR and, in descending hurriedly out of the clouds, tore off the port main landing gear when the aircraft collided with the water. He hauled the aircraft back into the air and subsequently landed on a mattress placed under his port stub wing. This accident was primarily a collision-with-water type accident but is included here as a landing with one main gear missing. The kind of damage which occurred in each accident or incident is shown in Fig. 2.

Wheels-Up Landings

Fiscal Years

Model	67	68	69	70	71	Total
H-2	2	--	3	2	2	9
H-3	1	5	2	3	2	13
H-46	--	--	--	1	--	1
H-53	1	1	--	1	2	5
Total	4	6	5	7	6	28

Fig. 1

The four instances (excluding the UH-46 accident) of intentional wheels-up landings involved the H-3 once and the H-53 three times. The H-3 landing gear partially retracted during a shipboard landing due to an electrical short in the landing gear control box, which actuated the circuit breaker prior to the gear reaching the full-down position. The landing gear indicator malfunctioned due to maintenance personnel error. A connecting wire, L2411A20, was hooked to the rotor headlight circuit breaker instead of the landing gear downlock relay and landing gear circuit breaker. This resulted in a SAFE landing gear indication regardless of the unlocked position of the gear. The three H-53 intentional wheels-up landings were all for the same reason; the nose landing gear failed to extend due to material failure of the nose landing gear centering device. This resulted in cocked and binding nosewheels in the wheelwell. In each instance, servicing of the nose landing gear strut was highly suspect. Improper servicing prevents the centering cam from engaging.

Damage Incurred

Model	A	C	D	E	F
H-2	1	--	2	6	--
H-3	--	1	2	9	1
H-46	--	1	--	--	1
H-53	--	--	--	5	--
Total	1	2	4	20	2

Fig. 2

The unintentional wheels-up landings, all 23 of them, were preventable. There were several instances, landing aboard ship, when the tower gave a green deck without asking for a wheels check (bad). There were several instances when the LSE permitted the aircraft to land without noticing that the wheels were up (very bad). These and the other instances occurred because the HAC simply did not use the landing checklist (worst of all). Keep in mind now that these were not single-seat helicopters. *In every case there were two pilots, qualified in model, in the cockpit.* Assuming that one of them was busy flying the bird, what in the world was the *other* guy doing?

In civilian life a boo-boo like this could get a guy fired or, if he owned the bird, could cost a heap! To avoid the mess of damaged aircraft, the time and effort in investigations and the blow to your morale because of a wheels-up landing, ensure that both communication and cockpit coordination are exercised *every time.* ◄

Short Snorts

Knowledge is what you learn from others;
wisdom is what you teach yourself.
Both are needed to fly safely.

Ace L.

Who Is Next?

GENTLEMEN, it happened again for the *umpteenth* time! A helicopter – this time a UH-46 – was started and the rotor system inadvertently engaged with the collective pitch control not properly positioned in the three-degree detent. When the condition levers were advanced to FLY the helicopter became airborne. The pilot quickly took control and landed the helo 10 seconds later on the taxiway about 150 feet away.

Good heavens! Great Pete! Caesar's Ghost! *Keeriminee!* What else can you say? Before a further discussion ensues of what events took place and why it happened, designate one member of your squadron or detachment to be a discussion leader. Have him solicit ideas from the rest of the group and write on a blackboard all of the conditions – what and why – which you think existed to set this up. Then turn to page 46 to see what the CO had to say.

Lost No. 2 – Feathered No. 1

AFTER three and a half hours of flight the plane commander of a C-47 elected to make a steep turn to avoid weather. At the time, both left and right auxiliary tank gages indicated 20 gallons each and had been operative approximately 3.3 hours. Under normal conditions this amount of fuel would have been sufficient to operate the engines another 30 - 35 minutes. However, during the steep turn, the right engine fuel pressure dropped and the right engine lost power. The plane commander quickly switched from both auxiliary tanks to the left and right main tanks. Although both boost pumps were placed ON, the right engine fuel pressure failed to recover.

Because he misinterpreted the fuel gage needles, the plane commander then shut down the port engine in accordance with fuel pressure drop procedures. With the port engine feathered and the starboard engine windmilling, the aircraft was descending at 500 fpm from an altitude of approximately 9000 feet. The first pilot, who had been out of his seat to eat his lunch, hurriedly returned to the left seat as the plane commander directed the crewmembers to prepare for bailout. He also directed the first pilot to read the restart procedures. The left engine was then restarted and the malfunctioning right engine feathered. Recovery was made at 3500 feet and an uneventful single-engine landing was made at an alternate field.

This incident was the result of pilot factor in that, in his haste to correct the situation, the plane commander misinterpreted the fuel pressure gage needles and shut down the wrong engine, thus compounding an already serious condition.

Supervisory error was evident in that the plane commander allowed the first pilot to be out of his seat an excessive amount of time during a period when the possibility existed of running the fuel tanks dry. There was also possible contributing pilot factor in that the engine-driven fuel pumps were exposed to air long enough during the steep turn to cause fuel pump cavitation.

This is a classic example of a pilot, who, in the heat of an emergency situation, reacts *too* swiftly instead of analyzing the trouble before feathering an engine. Fortunately, his training paid off when, with the help of the copilot, the bad engine was identified and the deteriorating situation was salvaged by referring to the secure engine checklist.

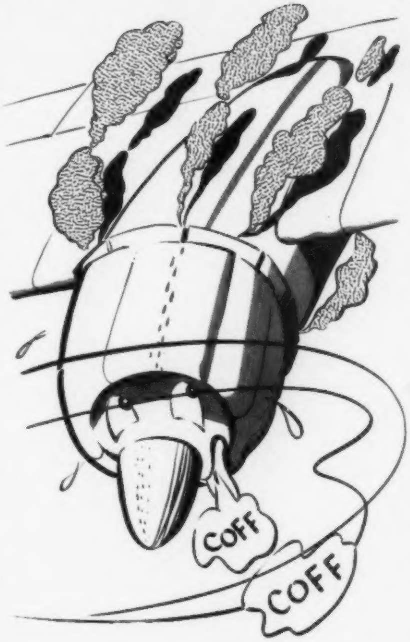
Fire In No. 4

"IF we have an inflight fire we'll determine which engine, and on my command you secure that engine and release the CO_2. I'll make an immediate turn back to the field and advise the tower of our problem. You begin the inflight fire

checklist and the two of you use the command and reply system." These were the words of the aircraft commander to the copilot and flight engineer of a C-118. It was the tail end of the usual briefing before takeoff and no one really expected to have to execute the procedures.

Their clearance had been received and the big transport moved into position and started rolling. Shortly thereafter, while climbing, the oil pressure warning light illuminated and was isolated to No. 4 engine. Engine instruments all indicated normal. (It was later determined that No. 4 fuse had blown.) Soon after the first indication, the fuel pressure warning light illuminated as well as intermittent illumination of the zone 2 and 3 fire-warning light on the No. 4 engine. Additionally, smoke was observed coming from the cowl flaps on No. 4 engine. This was no drill. There was an engine fire and quickly the plan announced by the aircraft commander in the briefing was carried out.

Fortunately, VFR conditions prevailed and the pilot, after declaring an emergency, quickly positioned the C-118 for an



approach and an uneventful landing. After landing, the fire trucks followed the aircraft and stood by while the aircraft was evacuated. The investigation did not pinpoint the cause but the best theory is that the bottom brush on the starter shorted out on the brush cover. As a result of arcing, a hole was burned through the starter casing. Pieces of hot metal fell to the bottom of the nacelle area and onto plastic and asbestos-covered fuel and oil lines in the engine accessory section area. Apparently, the oil soaked lines and some bits of debris in the bottom of the nacelle were ignited by the hot metal and were smoldering while the aircraft was taxiing, during takeoff and subsequent climb. The fire appeared to be the hottest around the area of the pressure transmitters since it burned through the electrical conduit and shorted out the electrical lines to the warning lights. The engine was feathered and the CO_2 bottles discharged just before the oil lines to the feather pump and the fuel lines from the fuel pressure transmitter burned through.

The CO commended the crew for their professionalism and for avoiding what could have easily developed into a catastrophic inflight fire.

The presence of any debris in the bottom of the nacelle area is a definite fire hazard! Pilots, aircrewmen and plane captains must realize this and ensure that the area is free of combustible materials.

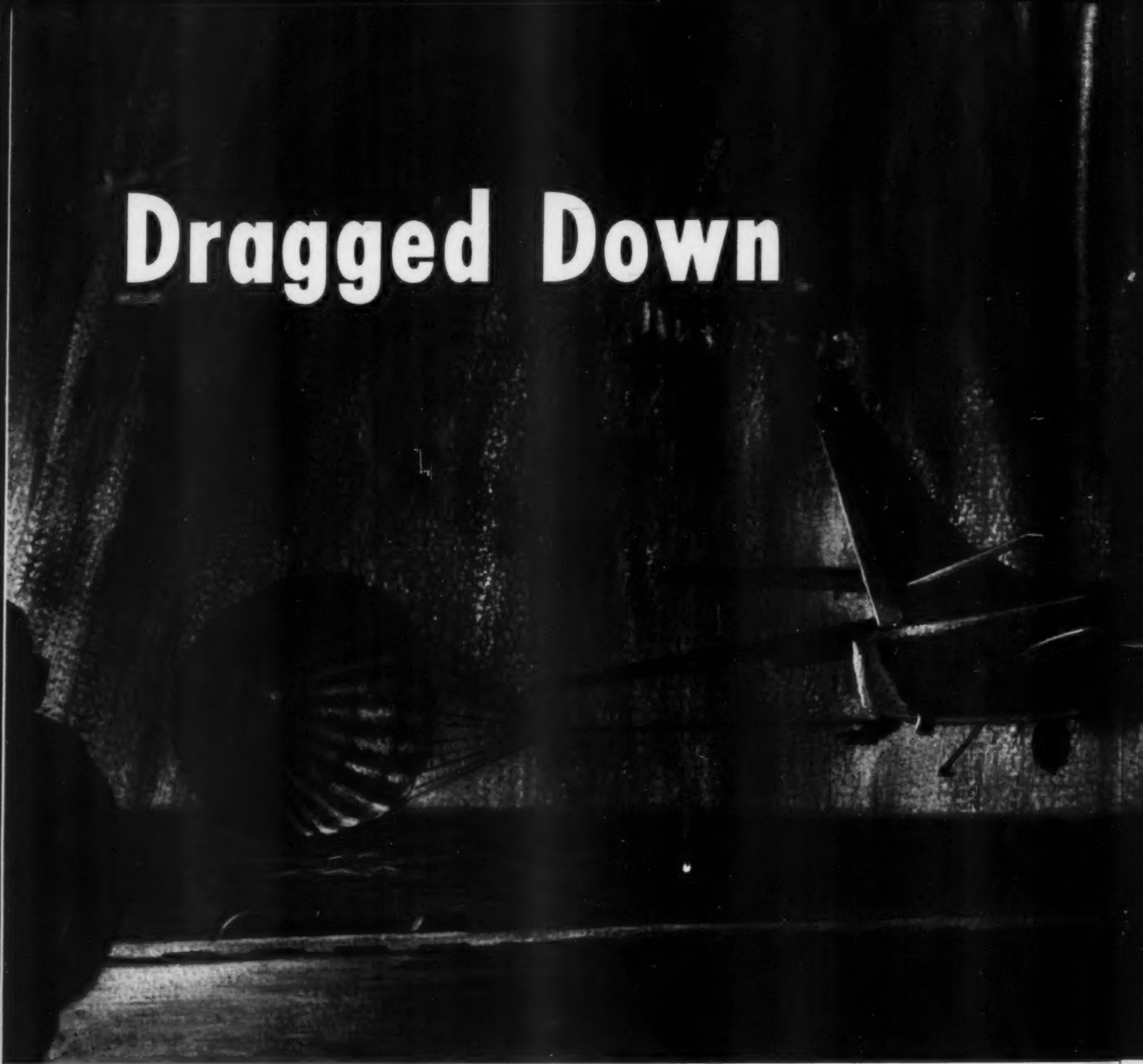
Well, That's Show Biz

AN F-8 and a T-33 were taxiing in a close formation to the line area following a 1.5-hour practice flight in preparation for the annual NAS airshow. During taxi, the starboard wingtip tank of the T-33 contacted the horizontal tail of the F-8, however, neither pilot was aware of this until both aircraft arrived at the line. The plane captain detected two long one-inch deep slashes in the outboard and inboard sides of the T-33's starboard wing tiptank.

During the incident investigation, the F-8 pilot stated that his aircraft's horizontal tail was in the full up position when taxiing back to the line. Measurements taken of the collision areas by the investigating officer revealed that the height of the slashes on the T-33 starboard wing tiptank coincided with the height of the outer tip of the *Crusader's* unit horizontal tail when in the full up position.

Taxiing aircraft in close formation is not a normal requirement of pilots attached to this NAS. It was only utilized in this instance to prepare for the upcoming airshow. The importance of constant vigilance during formation taxi, with particular attention to safe speeds and adequate clearance, cannot be overstressed, especially when the pilots performing this maneuver are not currently proficient at it.

Dragged Down



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AN EKA-3B was launched from a CVA at 2040 local time as a combat tanker. The mission proceeded normally until return to the ship. A Case III CCA to the ship ended with a fouled deck waveoff. The pilot then entered the waveoff/bolter pattern for another Case III approach. After a fuel state of 6000 pounds was reported on the ball at three-fourths mile, the aircraft was observed going below glidepath. The pilot responded to an LSO power call, the aircraft went flat in close and boltered. CATCC then directed a bingo to a shore station due to low fuel.

The crew had flown a two-and-one-half hour tanker mission earlier in the afternoon. Because of this they were instructed to attempt a turnaround and return to the ship for a 0015 recovery *only* if the pilot and crew were not tired. If tired, the pilot and crew were instructed to RON at the shore station and expect an overhead time in about 24 hours. The pilot acknowledged these instructions and added that he "probably" would be back.

The bingo flight to the shore station was uneventful. The pilot pushed the drag chute circuit breaker *in* during

the prelanding checklist. (It was squadron policy to have the drag chute circuit breaker out for operations off the ship.) After touchdown, the pilot actuated the drag chute but the chute failed to deploy. However, the aircraft was easily brought to a stop with brakes alone. After turning off the runway, the pilot taxied to the hot refueling pits. Upon arrival at the pits, the pilot remained in the aircraft but sent his two crewmen outside to assist in the refueling and to determine why the drag chute failed to deploy. The crewmen observed that the chute doors were closed. They also checked and determined that a drag chute *was* installed. After being informed of these facts, the pilot pulled out the drag chute circuit breaker and moved the drag chute to the jettison/stowed position. No further action was taken by either the pilot or the crewmen relative to the drag chute failure.

Taxi from the refueling pits, takeoff and return flight to the ship were uneventful. Upon arrival overhead at about 0025, the tanker assumed duty as overhead tanker for the recovery which was in progress. At the end of the recovery, a Case III CCA approach was commenced and excess fuel dumped. The approach proceeded normally to OLS transition and LSO control. Fuel state was reported at 6100 pounds.

At "meatball," the aircraft went below glidepath and remained below. The LSO made several power calls as the aircraft settled in close. The pilot overcontrolled power and the *Skywarrior* crossed the ramp a little low and flat. Touchdown was forward of the crossdeck pendants, resulting in a bolter. The drag chute fell out of the aircraft on touchdown and was fully deployed as the aircraft left the angle deck. The CATCC controller immediately began transmitting bolter pattern instructions as the aircraft began to settle toward the water. The second seat crewman called, "Power, boards," which is normal procedure. He then repeated, "Boards, boards," as he observed that the aircraft was not accelerating or climbing. The pilot rechecked the speedboard switch "in" several times, then raised the landing gear.

The pilot transitioned to instrument flight immediately following the bolter and, maintaining wings level, assumed the proper climbing attitude. When he observed that the aircraft was not accelerating or climbing, he increased the angle-of-attack to 16 units and held this attitude to impact. The rate of descent was about 100 fpm. Neither the pilot nor second seat crewman knew that the drag chute had deployed and was the cause of the altitude loss.

Although the LSO saw what appeared to be a drag chute drop from the aircraft, he could not observe the aircraft as it left the deck because of the parked aircraft to the left of the landing area. The LSO platform on this ship is located 36 inches below flight deck level, which precluded the LSO from moving rapidly to a better vantage point where he might have observed the drag chute in time to warn the pilot. However, 12 seconds after the aircraft left the angle deck, Pri-Fly called, "Get your chute, your chute." Even though this call was heard by the crew, its meaning was not understood and the aircraft impacted the water about two minutes later.

Following the impact, the aircraft remained essentially intact and afloat. None of the crewmembers

were injured and they left the aircraft with only minor difficulty. They were rescued by helicopter a short time later.

During the subsequent investigation, it was brought out that the drag chute had failed to deploy on three out of the last 10 field landings over a period of 45 days. On all three occasions the drag chute doors had failed to open. On the first malfunction the doors were found to be sticking. After the second malfunction, maintenance personnel replaced the drag chute actuator (Airborne Electronics PN R584M801). Thorough analysis of the actuating arm movement adjustment tolerances was made and revealed that there is only .031 of an inch excess travel of the actuator arm beyond that required to trip the spring-loaded doors open. Although the system was run through and functionally checked, as previously stated, the exact adjustments were not checked on the actuating mechanism. The Maintenance Instruction Manual, NAVAIR 01-40ATA-2-13, does not include the specific requirements for insuring proper adjustment of the actuator after installation. It should be noted that several successful chute landings were made following the first and second drag chute malfunctions. On the night of the accident, the third malfunction occurred but was not investigated by maintenance personnel to determine or correct the malfunction of the drag chute system.

A thorough study of the statements and interviews with the pilot and crewmen revealed:

- After the pilot pulled out the drag chute circuit breaker and moved the drag chute switch to the jettison/stowed position, the circuit breaker was never placed in for the takeoff or at any time during the flight to the ship.

- The pilot was very busy checking fuel coming into the aircraft and insuring proper fuel distribution in the refueling pit at the shore station. When informed by the crewmen that the drag chute doors had not opened and that the drag chute was still in the aircraft, the pilot, in an attempt to "safe" the drag chute, pulled the circuit breaker *first*, then placed the drag chute switch to the jettison/stowed position and immediately returned his attention to managing fuel distribution.

- The second crewman was aware of the pilot's actions in attempting to safe the drag chute and concurred, having no doubt that the chute was safe.

- The pilot did not feel the need for maintenance assistance because he thought he had adequately safed the drag chute system and did not consider a need for an operable chute on the field takeoff for possible abort considerations.

- At no time did the pilot consider that the need for an expeditious turnaround, to make the 0015 overhead time, had influenced the method he used to safe the drag chute or actions required to insure a safe chute. The pilot stated that the idea of removing the chute from the aircraft briefly crossed his mind but was discarded since he felt sure that his safing actions were adequate.

- The pilot and crewmen were not aware of a safety feature incorporated in the drag chute system which allows the chute to separate from the aircraft with a minimal load (250-pound load to shear a Monel rivet) when the drag chute and locking mechanism is in the stowed position. Also, they were not aware that actuation of the drag chute switch to the deploy position caused an electrically operated mechanism to move, locking the drag chute to the aircraft and increasing the load required to separate the chute from the aircraft to about 25,000 pounds. This is obtained at an airspeed estimated to be in the range of 170 to 180 knots. The crew believed that separation of the chute from the aircraft could be obtained only by cycling the drag chute switch to the jettison/stowed position, if the drag chute deployed as a result of mechanical failure which allowed the doors to open.

- The pilot and both crewmen denied that they were tired. They stated that they felt up to returning to the ship.

- The pilot's actions, in deploying the drag chute on landing at the shore station and subsequently pulling out the drag chute circuit breaker *prior* to returning the drag chute switch to the jettison/stowed position, placed the drag chute locking mechanism in the lock position. A 25,000-pound load would be required to shear the pin connecting the riser link to the drag chute. However, it is noted that a possibility exists that the actuator could have failed after locking the riser link. In this event, the only method available to the crew to safe the drag chute system would be to remove the chute from the aircraft.

The Board's analysis of NATOPS requirements and the pilot's actions indicates there was no violation of NATOPS procedures in this accident. Aircrew training programs are oriented around the areas emphasized in the NATOPS manuals. In the case of the EKA-3B NATOPS Manual, the coverage of the drag chute actuating mechanism and the safety features incorporated were inadequate (at the time of the accident) and is the primary reason why sufficient aircrew knowledge of the system was lacking. The aircrewmen's training records indicate that they were current in their NATOPS requirements and that they had received sufficient training commensurate with current directives. The inadequacy of the NATOPS manual has since been remedied by the addition of certain changes to pages 1-88A and 3-30 of the EKA-3B NATOPS Manual.

There is evidence that both pilot fatigue and material malfunction (failure of the drag chute doors to open upon landing at the shore station) were important factors in this accident; however, one of the most important lessons learned is that knowledge is power. Had the pilot been fully aware of all the ramifications of the operation of the drag chute system, this accident might not have occurred (fatigue and material failures notwithstanding). As the Board pointed out, the pilot did act in accordance with NATOPS insofar as it went. Therefore, accidents such as this should provide a strong impetus for all concerned to review NATOPS manuals to insure they are sufficiently detailed to enable pilots to understand the operation of essential systems.

Pit Traps and "Wingless Flight"

DURING the month of March 1971, two Navy aircraft attempted flight with folded wings. One, an F-4J, successfully landed. The other, an A-7E, did not. Although the primary cause of both of these mishaps was the pilot's failure to use the checklist, the overriding contributory factors are similar. Both aircraft were involved in a night refueling turnaround in the fuel pits. Both pilots were in a hurry.

Preliminary research has shown that "wingfold takeoff attempts" are by no means isolated, and a rapid turnaround in the fuel pits is the predominant trap. Other accidents caused by a breakdown in habit pattern or procedure can start in the fueling pits and include; failure to reset trim, hot brakes, an assumption that the aircraft has been completely fueled, etc. Indications are that these "pit-related" accidents are considerably more prevalent than would, or should, be expected. NAVSAFECEN is presently extracting additional data for further analysis of the problem.

The commands involved in the two wingfolded flights have conducted a review of their procedures. All air stations and squadrons would be well advised to examine "pit traps" in depth rather than concentrate solely on the wingfold phenomena. In this respect, squadron COs and safety officers cannot disclaim a share of responsibility for those functions under the cognizance of the air station. They must satisfy themselves that the instructions and training of wheel watches, pit operators and wheel checkers are adequate enough to provide the expected safeguards and complement internal squadron procedures.

Adapted from NAVSAFECEN Flight Advisory 3-71

Midair!

. . . a terrified voice screamed over the radio, *"Midair! Midair! Lead has had a midair collision!"*

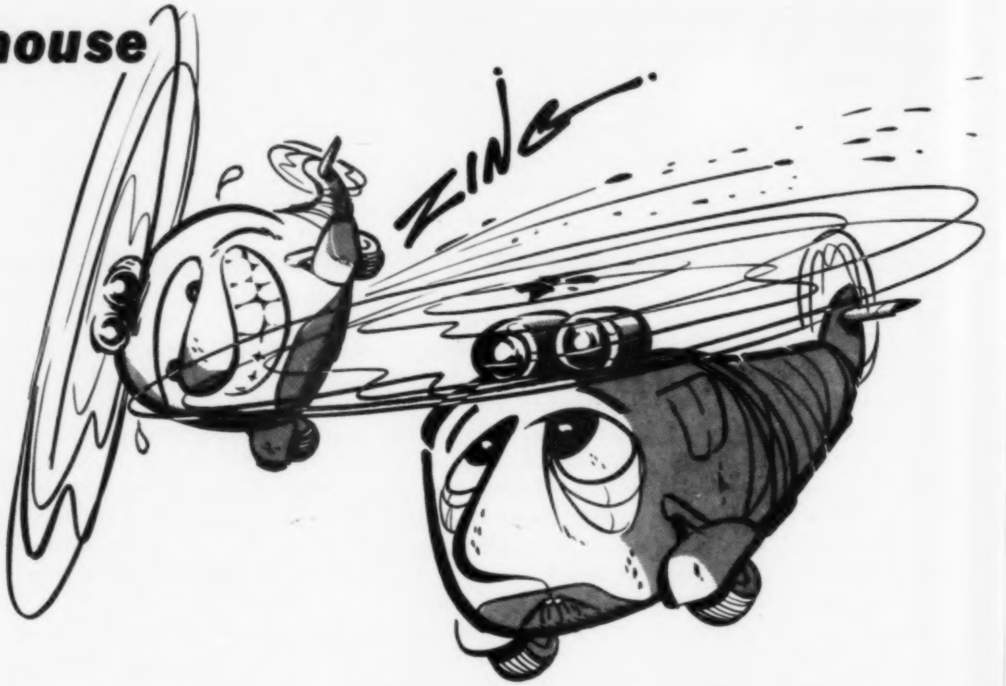
The other aircraft immediately broke off and started to orbit outside the area. Two *slicks* were sent in – first to make a low pass over the burning wreckage, and then to land and drop troops to secure the area. One of the pilots on the ground confirmed everyone's fear, "There are no survivors."

The *slicks* finished their job and returned home, while my ship and one other remained to wait for a CH-47 *Chinook* to come with fire buckets to put out the fire. As we circled we could see the ammo on the crashed ships exploding and sending tracers out into the darkness. The glow of the fire threw unwanted light onto the scene. When the *Chinook* arrived the fire was quickly extinguished. There was nothing else that could be done until morning, and since it was almost 0400 we returned home. Although extremely fatigued, no one slept much that night.

"I have only been in aviation three years and have witnessed two midair collisions. The reasons for both were the same: an aircraft being in an area where it didn't belong and inattention." . . . *An aircraft being in an area where it didn't belong and inattention.*

Excerpt From "Two Midairs – Enough To Last a Lifetime"
By CW2 Randall B. Cassels
Courtesy of U.S. Army Aviation Digest

Anymouse



Hey, Look Me Over!

THIS is what I heard over the radio circuit:

Yo-Yo 2: Ah, Yo-Yo 1, you have something hanging loose and flapping in the engine nacelle area.

Yo-Yo 1: Slide in closer and take a reading. Be more specific if you can. All my gages are normal and I don't have any unusual vibrations.

Yo-Yo 2: Rog. (moments later) I can see better now. It looks like an unfastened secondary engine cover latch. I don't think you're in any danger from it. *OOPS!*

The section of SH-3s were operating not far from their floating home-away-from-home during their conversation. Just as Yo-Yo 2 finished his report the two choppers had a midair. It wasn't catastrophic, by the proverbial gnat's eyelash, but it was close. So close, in fact, that one crewman in Yo-Yo 2 is alleged to have held his breath for the entire four minutes it took for both helicopters to get aboard. Yo-Yo 2 had a moderate one-to-one vibration shaking his helicopter.

After the pilot of Yo-Yo 2 made his report to Yo-Yo 1 on what was loose and as he was about to open the distance between the two helos, his main rotor blades contacted the tailwheel of Yo-Yo 1 slicing the wheel assembly from the axle. Both aircraft remained controllable and headed, posthaste, to the carrier and landed.

In addition to the obvious damage, a P & E team inspected the two aircraft and recommended replacement of all blades on Yo-Yo 2 (main rotor and tail rotor) as well as replacement of the ground, discharge, tailwheel fairing, and housing assemblies on Yo-Yo 1.

The pilot of Yo-Yo 2 reported that, even though there was no turbulence nor control malfunctions, his helicopter appeared to be drawn (sucked) into Yo-Yo 1.

Breathlessmouse

Now, right "theyah" in the last sentence, friends, is a big fat clue why Yo-Yo 2 dinged Yo-Yo 1. It

The purpose of Anymouse (anonymous) Reports is to help prevent or overcome dangerous situations. They are submitted by Naval and Marine Corps aviation personnel who have had hazardous or unsafe aviation experiences. These reports need not be signed. Self-mailing forms for writing Anymouse Reports are available in readyrooms and line shacks. All reports are considered for appropriate action.

REPORT AN INCIDENT, PREVENT AN ACCIDENT

can't be stated categorically that Yo-Yo 2 became a victim of Yo-Yo 1's vortex core but we'd be willing to bet two sugar-coated doughnuts against one jelly roll that is exactly what happened. When Yo-Yo 2 slid in for a closer look, in all probability, he was below and behind Yo-Yo 1 – in the exact position to have the lead's vortex core pull him in like a big magnet. All pilots involved in closely inspecting another airborne aircraft, for any reason, should not forget the continuous presence of wingtip or rotor blade vortices of the generating aircraft. The prime requisite in formation flying and inspection is the safety of the two aircraft, and of least importance is "looking good" or sacrificing safety in order to get close enough to pinpoint the trouble. Single-seaters do not have any extra eyes to help see what's wrong, but multiseaters should have one pilot flying and another set of eyes or two trying to determine what's what.

Sunglass Lenses

THE PRESENT sunglasses (FSN 9D8465-753-6261) being used by pilots and aircrewmen are a hazard due to the fact that they chip and shatter when hit. Particles of glass could easily become lodged in the wearer's eye. The glass lenses should be replaced by a plastic type.

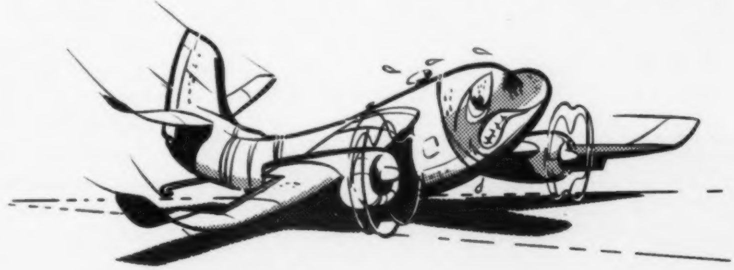
Anymouse

This is a problem which will literally disappear in time, as far as new *sunglass lenses are concerned. Beginning 31 December 1971, manufacture of impact-resistant eye and sunglass lenses will be compulsory under conditions listed in the Federal Register, Vol. 36, No. 95.*

On current policies on conservation of eyesight in general, OPNAVINST 5100.14 of 11 August 1970, Manual of Shore Safety Program Regulations and Accident/Injury Reporting Techniques, covers the Navy's sight conservation program for civilian employees and military personnel. COs are responsible for implementing the sight conservation program in their activities. When the activity eye hazard determination committee makes recommendations, a CO can state by directive that eye protection must be worn by persons engaged in certain operations or by persons entering areas designated as eye-hazardous. A table of various types of protective eyewear appears in NAVMAT P-10470, the Safety Equipment Manual, July 1969.

On the Value of Using the Checklist

I was the pilot of a C-1A undergoing initial night carrier qualifications on a large CVA. The plane commander (copilot) and myself had extensive experience in twin-engine tailhook type aircraft.



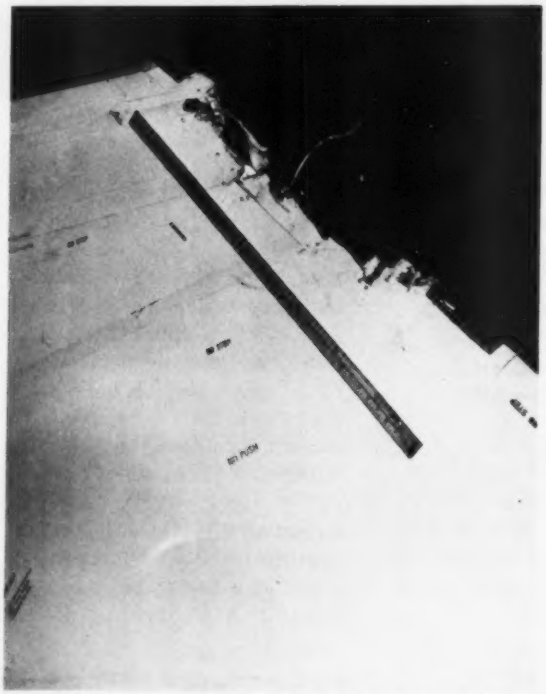
The flight progressed smoothly until the fourth pass when everything turned to worms. On this pass, after receiving and taking the cut, the LSO transmitted a frantic waveoff by radio. I responded with an equally frantic application of power and successfully executed a waveoff with the hook clearing the crossdeck pendants by an estimated four inches *with the landing gear up!*

How did two experienced pilots get to the cut position with the landing gear up? The explanation is painfully simple – *failure to use the checklist*! How did the wheels-up approach go undetected through the cut? There were two C-1As in the pattern; the approach light in the other aircraft was inoperative. When we turned onto final with wheels up and approach light out, the LSO assumed we were the aircraft without an approach light, so he was not unduly concerned. The LSO talker reported all down. At the time the pass was made, the controlling LSO was under instruction, with the experienced LSO busy writing up a previous pass. When the LSO under instruction gave us the cut, the other LSO looked up and noticed the wheels up and initiated the waveoff. So a wheels-up pass which normally would have been detected early and only been an embarrassing (and a bit expensive) experience for the pilots concerned, ended as a frightening experience for the pilots and everyone on deck. I still shudder when I think of what would have happened had we received an inflight engagement with full power on and gear up or had the props contacted the deck on waveoff.

C-1A Mouse

Your report is an excellent testimonial to the value of using prescribed checklists. Well said.

AMBUSHED



View of the damaged F-8J starboard wingtip.

Damaged area showing the initial contact point on the *Cherokee's* port wing.

"WATCH for the smoke signals men, some military type just winged a *Cherokee*." What's this, a big line from a cliche-filled old cowboy and indian flick showing on the late, late, late show? Could be, but it isn't. It has to do with a midair collision between an F-8 *Crusader* and a Piper *Cherokee* which took place not too long ago. Except for the presence of a horseshoe and maybe a medicine man, this particular mishap could have had disastrous results. Follow along and see what happened.

The pilot of an F-8J was returning to NAS Outpost from a local area familiarization flight. The *Crusader* was on a heading of 225 degrees at an altitude of 8500 feet MSL under VFR conditions. Approaching the VFR entry point to the NAS, the pilot noted a "reddish object" in his peripheral vision. He took immediate evasive action by rolling the aircraft hard to port. Continuing in a port climbing turn, he scoured the sky for some indication of what he had seen. After completing 360 degrees of turn and observing nothing but a wide expanse of hazy blue sky, the pilot headed for the NAS where he made an uneventful landing.

The F-8 driver taxied to the squadron line, shut down and exited the aircraft. While conducting a postflight inspection he detected a damaged starboard wingtip and for the first time realized that his aircraft had been involved in a midair collision with the unknown object he had seen. He immediately made this fact known to the squadron duty officer who then contacted local FAA officials to determine if any other aircraft had

Another view of the resultant damage to the *Cherokee's* port wing.

D CHEROKEE

reported being in a midair collision. It didn't take long to discover that the object the pilot had seen, and collided with, was a Piper *Cherokee*.

The pilot of the *Cherokee* reported that, at the time of the midair collision, his aircraft was heading southwest at an altitude of 8500 feet MSL. He was on a VFR point-to-point flight plan from This Field to That Field. About 35 minutes from destination he felt a severe jolt and knew his aircraft had been hit; however, he had no idea who the culprit was since he never saw the other aircraft. Following the mishap, he continued on to That Field and made a safe emergency landing.

The F-8 received limited damage to the starboard wingtip requiring an estimated 30 man-hours to repair. The port wing of the *Cherokee* was so badly damaged it had to be replaced. (Accompanying photos show the damage sustained.)

Investigation revealed that the F-8 was on a flight path approximately 25-30 degrees relative to the *Cherokee* and overtook the civil aircraft in the vicinity of its aft port quarter. The *Crusader's* starboard wingtip contacted the port aileron of the *Cherokee* and continued forward exiting at the wing leading edge.

The cause factor for this mishap was the failure of the F-8 pilot to maintain a proper lookout. Although visibility was limited by haze and the forward view further restricted by the sun, he had the primary responsibility for collision avoidance since his was the overtaking aircraft. The pilot estimated that his indicated airspeed at the time of the collision was 350 knots. This was a contributing cause factor in that this speed violates OPNAVINST 3710.7F which states, in part:

"In order to reduce the midair collision hazard associated with high aircraft speeds at low altitudes, FAR Part 91.70 imposes a maximum airspeed limitation of 250 KIAS on all aircraft operating below 10,000 feet MSL in airspace where FAR Part 91 applies and a maximum of 200 KIAS for aircraft operating in airspace beneath the lateral limits of any terminal control area (TCA)."

The F-8 was at a relatively low gross weight, about 24,000 pounds, and was returning for a landing approach. Its mission at the time of the collision did not require an airspeed in excess of 250 KIAS.

This incident is indicative of what can happen when pilots of high-performance aircraft, operating at low altitudes, fail to keep their eyes open. Imagine the sick feeling the civilian student pilot of the *Cherokee* must have had when he realized his port wing was pretty well torn up. Fortunately he kept his cool and landed without further mishap.

The smoke signals we mentioned at the beginning of this article could very well have been from one or both of these aircraft as they lay bent and burning on the terrain below. With only one pair of eyes available in the cockpit, it is mandatory that pilots of single-piloted aircraft stay extra alert for the possibility of a midair collision when flying at low altitude in high-density areas. Recent midair collisions involving the loss of lives, aircraft and property bear this fact out loud and clear.

Squadron COs, put a feather in your cap by calling for a pow-wow now so that you might stress to your pilots the importance of following existing flight rules, both military and civilian. This could help save *their* scalps, the *Navy* wampum and *you* from scouting around for new pilots and aircraft.

Safety Tip

RECENTLY, an aircraft incident was reported where a C-1 crewman was injured when his seat broke loose during a catapult launch. This prompted message traffic directing special inspection of C-1 seat fittings. One week after the inspection a similar incident occurred, again due to a C-1 seat being improperly secured.

Reporting, analysis and dissemination of safety information does not complete the job. The information is useful only so long as the proper personnel are made aware of the problem to the point where continuing corrective action is assured.

COMNAVAIRLANT Weekly Safety Bulletin

Oil Leak +

AT the early morning briefing aboard USS FLATROOF, the flight crews of two sections of CH-46s were thoroughly counseled about SAR procedures (should the need for such arise). Later, when a SAR plan had to be put into operation, the time spent on the briefing turned out to be well spent. When the flight crews manned their aircraft, two of the birds were down with mechanical problems. One of the crews switched aircraft, and the mission began with one aircraft from each of the original two sections forming a single section.

The mission was to proceed to USS SQUAREND, 60 to 70 miles away, pick up a load of passengers and

+ Overspeed = Ditch

return to FLATROOF. Both aircraft reached SQUAREND without incident. After refueling and loading the passengers aboard, the aircraft started back to FLATROOF. About halfway to their destination, one of the CH-46s experienced a loss of engine oil pressure and a rise in oil temperature on the No. 1 engine accompanied by considerable amounts of smoke. The crew chief reported to the HAC that he could see oil streaming out of the No. 1 engine compartment door. The HAC decided to secure the malfunctioning engine. Airspeed was reduced to "best single-engine airspeed" but the pilot was unable to maintain altitude with the load he had onboard – 23 passengers and crew. To lighten his aircraft, the HAC dumped fuel while the crew chief directed jettisoning of all loose cargo and baggage. Additional power was needed to stay airborne, so the pilot went to emergency throttle. The combination of reducing the weight of the aircraft plus additional power enabled the HAC to fly straight and level about 200 feet above the water. Meanwhile, the crew chief was busy reviewing ditching procedures with the passengers and checking their survival gear. He made doubly sure that all the passengers knew which exits were to be used in the event of ditching. They were prepared.

Meanwhile, the two aircraft which were downed at the start of the mission had been fixed and were enroute to SQUAREND when they heard the emergency in progress. They were diverted to accompany the ailing helo and directed to act as SAR aircraft.

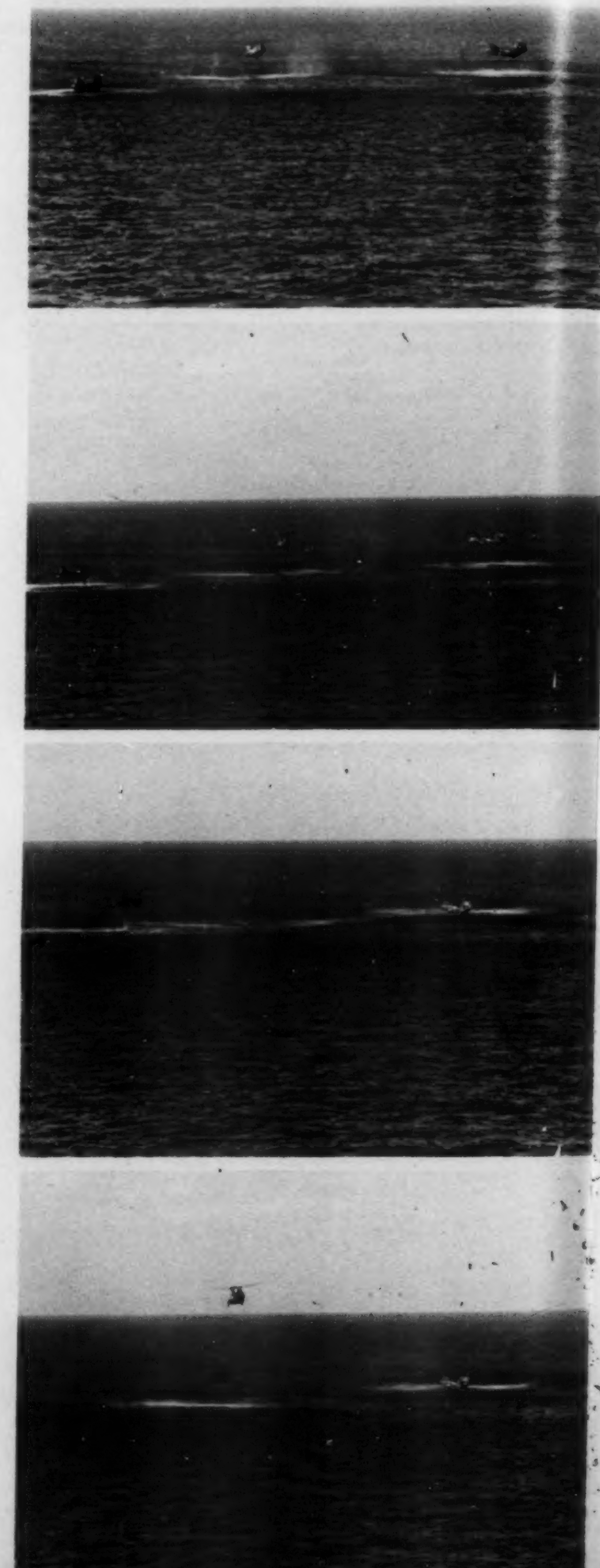
As the helo in trouble approached within 10 miles of

FLATROOF, the HAC dumped more fuel and was able to climb to 400 feet. He had asked for a clear deck and intended to make a straight-in approach and roll-on landing. Unfortunately, the relative positions of FLATROOF and the helos meant a downwind approach. This extra time turned out to be the difference between landing aboard and getting wet.

As the HAC made his turn at the 180, both pilots noticed T_5, as well as N_r and N_g, rising (not good). When the crew chief saw these gages headed toward the red line, he knew they would not make it aboard and directed all passengers to prepare for the inevitable. Simultaneously, while turning and descending, the No. 2 engine quit! The wingman, who had stayed right with the section leader all the way, saw puffs of white smoke, soon followed by a large cloud of white smoke, emitting from the leader's engine. As his No. 2 engine gave up, the HAC entered an autorotation and landed in the water with full control. The sea was relatively calm but the impact with the water broke out the chin bubbles which destroyed the watertight integrity of the helicopter. The aircraft began to sink and the passengers and crew began evacuating even before the rotors stopped. It sank in about 45 seconds, in deep water, and was not recovered.

Since the aircraft was lost, there is no certainty as to why the No. 2 engine quit, but the AAB offered a hypothesis. The pilot failed to control the RPM, while changing (lowering) the collective pitch position, which is required when operating on emergency throttle. This was attributed to a lack of training. The lack of training was based on a mixed bag of aircraft in the squadron – some with the emergency throttle and some without – a rather cursory explanation of emergency throttle system operation and related hazards in the NATOPS manual and reluctance on the part of squadrons to initiate training in the use of a system about which little was known. The opinion of the AAB was that No. 2 engine performed in the designed manner and the apparent failure was actually the engine overspeed protection working *as advertised*. The electrical (automatic) overspeed protection is bypassed with selection of emergency throttle, leaving only the fuel shut-off feature to prevent engine disintegration in the event of overspeed. The AAB brought out the fact that the fuel cut-off feature of the engine, when using the emergency throttle, is only casually mentioned in the NATOPS manual and has recommended that a *Warning* be incorporated in the manual.

All hands were promptly rescued but a dangerous situation arose during the SAR effort. There were many aircraft on the scene, but an on-scene-commander was not designated and rescue efforts were not coordinated.



As a result, the pilots of the rescue aircraft proceeded about their pickup job independently and a midair was narrowly averted. One helicopter, after landing on the water to pick up survivors, lifted and almost backed into another helicopter which had remained airborne while picking up survivors by hoist.

The CO, in his endorsement, stated that the squadron had begun training in the operation of the emergency throttle and that a *Warning* had been written and submitted for a NATOPS change. He also commented on the importance of pilot cockpit coordination and the necessity of both pilots being aware of any hazardous situation, so that either pilot can act to remedy the situation. The CO of FLATROOF attributed the successful mass rescue effort to the professional performance of the SAR crews. When sea conditions permit, he recommends on-water rescues for numerous survivors as opposed to hoisting them individually. He also took the responsibility for developing an on-scene-commander plan to control and coordinate rescue operations. Another endorser established a requirement to conduct on-water rescue training, under controlled conditions, for H-46 crews.

Particular note should be made here relative to the beginning of personnel evacuation with the rotors turning. We will not knock success because this aircraft ditching did end up without injuries to anyone. However, other types of helicopters might not float high enough out of the water to permit personnel to get out while those big rotors are still flailing. In other words, if the helicopter is sinking more rapidly than this CH-46, anyone in the water could have the rotor blades spoil his whole day. Generally (if possible), crew chiefs should keep passengers inside the ditched aircraft until the rotor blades have stopped. Needless to say, cockpit coordination should be such that applying the rotor brake is priority item No. 1 after ditching, *when there is no power available to attempt a single-engine takeoff.* There is usually plenty of time for the HAC and the copilot to thoroughly discuss ditching details when one engine is still operating and the crew is proceeding to the nearest landing site. *HACs, do not leave anything to chance.* Brief the copilot and the crew chief on *what* you want done, in *what order* you want it done and *by whom* you wish it to be done.

As a result of this accident, COMNAVSAFECEN sent a questionnaire to all CH-46 operators. After the answers were received, they were compiled and a conference on the operation of the emergency throttle was convened. Three major results of the conference with Boeing Vertol ensued: first, a NATOPS change was promulgated; second, briefing teams from the contractor visited all operators; third, audio-visual aids have been procured from the contractor and are being distributed to all CH-46 operators. – Ed.

An Explosive Situation

DURING a weapons handling safety survey onboard USS KITTY HAWK (CVA-63), LCDR R. L. Brake, OIC, WESTPAC Weapons Handling Survey Team, recommended to the KITTY HAWK Weapons Department that some method be devised to prevent removal of live 20mm ammo from the M61 ammunition loading cart. It had been reported that ammo was being pilfered from open carts on the hangar deck.

Lieutenant Commander H. J. Downey, ordnance handling officer, took the above recommendation quite seriously and designed the cover shown. Whenever a loaded cart is unattended on the hangar deck, the cover is locked. It is removed just prior to the cart being taken to the flight deck for aircraft loading.

Downey's idea was recommended to NAVAIRSYSCOM, who in turn requested that NAVSAFECEN make it available to ships and squadrons through this publication. Those desiring further information should contact KITTY HAWK for details.

Under no circumstances should anyone pilfer live ammo. Not only do you put yourself in danger by storing live rounds in some hidden area aboard ship, but you put all of your shipmates in jeopardy as well. If anyone has unauthorized live ammunition in his possession, turn it in before a serious mishap occurs. The handling of live ammunition by qualified personnel is a dangerous business. For the unqualified it can be catastrophic.

Interrupted Speed Run

A YOUNG FRP (fleet replacement pilot) took off in an F-4B for his second syllabus familiarization flight. An experienced instructor pilot occupied the rear seat. The flight was normal in all respects until a supersonic speed run was attempted. As the F-4B accelerated through mach 1.8, the FRP observed the ball in the turn and slip indicator to drift slowly to starboard. Just as rudder was being introduced to recenter the ball, the aircraft suddenly shook violently and began to vibrate. The instructor pilot immediately instructed the FRP to "get the nose up and slow down."

After the FRP had slowed the aircraft and regained full control, both pilots began to look for possible damage. The aircraft had a utility hydraulic failure, a damaged port leading edge flap, and the forward windscreen was covered with a heavy film of hydraulic fluid. In addition, an inspection by another aircraft revealed that the radome and radar antenna were missing.

The aircraft was returned to homefield where the FRP dropped the tailhook and made two attempts at a GCA straight-in approach to a short field arrested landing. Neither attempt was successful because the pilot was unable to see the runway due to the hydraulic fluid on the windscreen. He then attempted a circling approach and, with the aid of an LSO, was able to touch down on the centerline of the runway about 3000 feet short of the E-14 bidirectional arresting gear. After touchdown the *Phantom* started drifting toward the starboard side of the runway, engaging the arresting gear at the extreme starboard side, causing the tailhook to release the wire. The aircraft departed the starboard side of the runway after 4200 feet of roll and continued 2200 feet further until it came to rest in soft sand. Both pilots evacuated the aircraft uninjured.

Subsequent investigation brought out the full extent of the problem which this young, inexperienced pilot faced in landing the aircraft. As noted, the aircraft had sustained damage to the port leading edge flap while airborne. This necessitated a no-flap approach and landing. In addition, the aircraft had utility hydraulic failure which severely degraded normal aircraft braking and rudder control, and rendered the nosewheel steering inoperative. The aircraft pitot-static system had also been damaged, making the airspeed indicator and altimeter unreliable. Poor communication with the instructor pilot in the rear cockpit, little or no visibility through the forward windscreen and poor visibility at homefield further complicated the landing problem.

Investigators considered the possibility of a material failure having caused the separation of the radome. With no firm evidence indicating a material failure, the investigators turned their attention to the maintenance and service history of the aircraft. It was determined that the radome had been opened on the morning of the day of the accident by fire control shop personnel in order to work on a defective radar transmitter. Both men involved stated that they had properly secured the radome upon completion of work at 1045. Thereafter, at about 1100, the plane captain performed a daily preflight on the aircraft and noted that the starboard upper locking bolt of the radome was not properly secured. It was also noted that the radome was not completely closed on the upper starboard collar. These discrepancies were recorded on the daily inspection card and reported to maintenance control.

At this point, there appears to have been a communications breakdown. Maintenance control personnel stated that they notified the fire control shop of the discrepancy; fire control shop personnel denied that they received any such notification. Investigators concluded that maintenance control did, in fact, notify the fire control shop of the discrepancy, but phrased the information in such a manner that fire control shop personnel thought it was a request for confirmation of their earlier work. In any event, inadequate maintenance supervision was evidenced by the following:

- The fire control shop did not request an inspection of the radome for security by a collateral duty inspector after completion of the work.

- Maintenance control called in the aircraft as being ready for flight prior to the time the radome discrepancy was written off on the daily inspection card.

Investigators listed the cause of this accident as undetermined. Regardless, the investigation confirmed beyond any doubt that all maintenance actions on an aircraft must be coordinated by maintenance control, and that appropriate quality assurance inspections must be completed. It's the only way to insure the readiness of an aircraft for flight. ◄

USN Emergency Field

Arresting Gear

Illus 23-26

Operations personnel are encouraged to remove and post the center foldout depicting U.S. Navy Arresting Gear in unit navigation planning spaces or readyrooms. It is suggested that explanatory material, found in the basic article, be used to complement the illustrations. Another recommendation would include posting the maximum engaging weights and airspeeds for aborts, roll-on, and fly-in type arrestments for the unit's aircraft. Specific, detailed information may be found in the NATOPS Flight Manual and the appropriate ARB (aircraft recovery bulletin).

THERE is a wide variety of emergency field arresting gear in use at U. S. military airfields throughout the world. In fact, there are so many types (or combinations of types) that the average pilot may be hard-pressed to properly evaluate the capabilities of the gear available, particularly when operating into or out of unfamiliar fields. Moreover, what may be essentially the same type of arresting gear will have one Navy designation and another Air Force designation. To clarify this matter, Chart 1, (see page 26), has been prepared to relate various Navy designations to the Air Force designations. While Navy and Air Force gear *may* be identical, the chart should be taken to indicate only that they are *roughly equivalent.*

Arresting Gear – A Valuable Aid

The value of emergency field arresting gear in preventing or minimizing accidents can hardly be overestimated. During 1969, for example, there was a total of 2818 recorded emergency arrestments. The maximum weight arrested was 98,000 lbs at a speed of 100 knots; the maximum speed of arrestment was 185 knots (23,000-lb aircraft). The tabulation on page 24 provides additional information on the overall U.S. Navy emergency field arresting gear experience. It should be noted that several of the types of gear listed are now installed at only a few places and are in the process of being phased out of service.

Various references are made in this article to the

U.S. Navy Arresting Gear

Type	No. Systems Presently Installed	No. of Arrests in 1969
E-5/MA-1A	5*	86
E-14-1	3*	127
E-15/E-15-1	44*	813
E-27/E-27-1	3*	161
E-28	115**	1232
M-2	231*	317
M-21	32** +	63 + (emergency)

* Number of systems installed is decreasing.

** Number of systems installed is increasing.

\+ The M-21 originally intended for SATS (short airfield for tactical support) application, has also been employed as an emergency system. The majority of systems now installed are for operational use rather than emergency use.

Note: E-6 and E-16 arresting gears have been removed from the Navy's inventory.

arresting capabilities of arresting gear. These references are for the purpose of illustration only; they should not be relied upon for determination of the weight and speed combinations at which engagements can be made in actual situations. To determine this information, you should consult the pertinent ARB (Aircraft Recovery Bulletin) for the type gear involved (refer to Chart 2).

E-15 and E-27 Arresting Gear

These types of emergency arresting gear are bidirectional and designed as landbased emergency standby gear for arresting tailhook-equipped aircraft. The arresting engine is a rotary friction-type energy absorber and is designed to dissipate the energy of a landing aircraft. All types of E-15 and E-27 arresting gear use essentially the same engine for arrestment, although engine components may be changed as necessary to suit individual installation requirements.

Aircraft arrestment is accomplished by the engagement of the aircraft arresting hook with a deck pendant which spans the runway. During runout the kinetic energy of the arrested aircraft is absorbed by the rotary friction arresting engine. The arrestment is entirely automatic. The arresting gear engine is activated when the aircraft arresting hook engages the deck pendant, thereby pulling out the attached purchase tapes. As the tapes unwind, the reels rotate, turning sprockets which simultaneously drive a hydraulic pump and rotate a valve cam. The pump supplies pressure to the friction brakes and the amount of pressure supplied is programmed by the amount of restriction in a cam-controlled valve. The brake application decreases the rotational speed of the reels, thereby slowing down the purchase tape payout which in turn applies a braking force on the aircraft.

Arresting engines for both the E-15 and E-27 may be installed above or below ground (in a pit). Typical E-15 and E-27 installations are illustrated in Figs. 1 and 2.

E-28 Arresting Gear

The E-28 is a bidirectional emergency recovery system capable of arresting aircraft ranging up to 78,000 lbs in weight with engaging speeds up to 160 knots. The newest USN system currently available, the E-28, is configured with twin energy absorbers, one on each side of the runway. Each absorber includes a fully wound drum of nylon purchase tape, the free end of which is connected to a wire rope pendant that is stretched across the runway. A typical E-28 installation is shown in Fig. 3.

During arrestment the pendant is engaged by the tailhook of the aircraft. Forward motion of the aircraft causes the tape to unwind as the energy absorber provides the braking action required for arrestment. Each absorber has a rotor and stator arrangement in a container of hydraulic fluid (water/glycol solution). The rotor converts the rotary motion of the tape drum to fluid motion and then to heat, thereby dissipating the kinetic energy of the aircraft. The heat generated by the arrestment is dissipated through the fluid with the aid of a cooling system. Once the aircraft is stopped and disengaged from the pendant, a gasoline engine-powered retrieve system rewinds the tapes, returning the E-28 to battery position.

E-5/E-5-1 Chain Type Arresting Gear

The E-5 and E-5-1 emergency chain arresting gear equipment consists of dual arresting cable installations which can be rigged for either single or bidirectional arrestments of aircraft (Figs. 4, 5 and 6). Bidirectional chain arresting gears are so designed that arresting cables may be attached to either end of the chains. The chain

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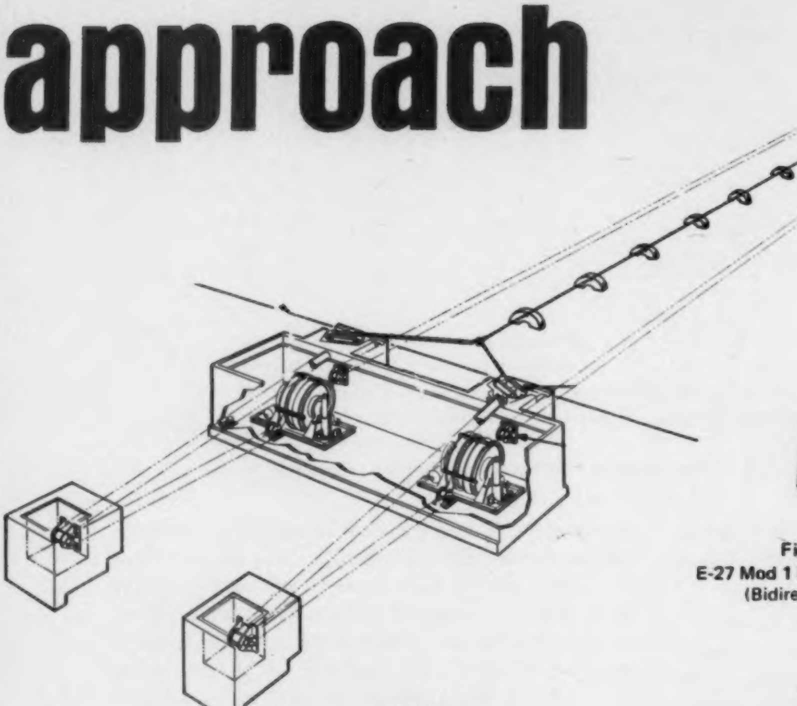


Fig. 1
E-15 Mod 1 Pit Installation
(Bidirectional)

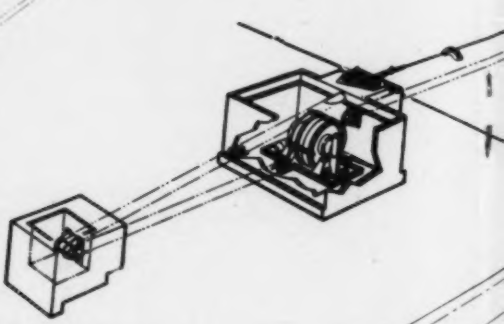
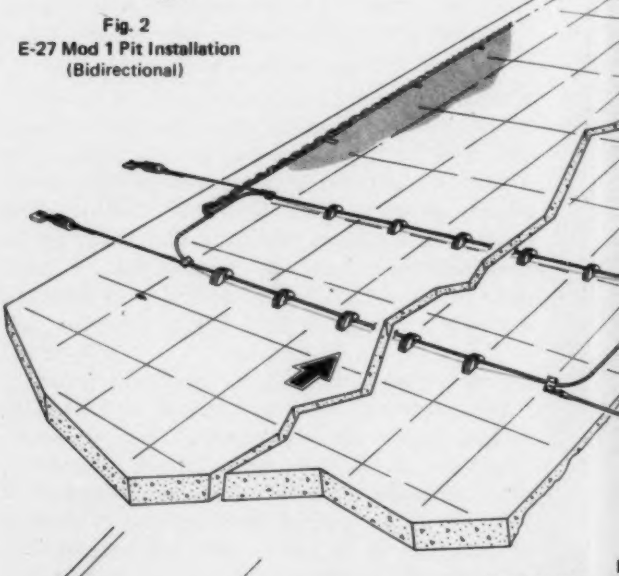


Fig. 2
E-27 Mod 1 Pit Installation
(Bidirectional)



E-5 Field Emerge

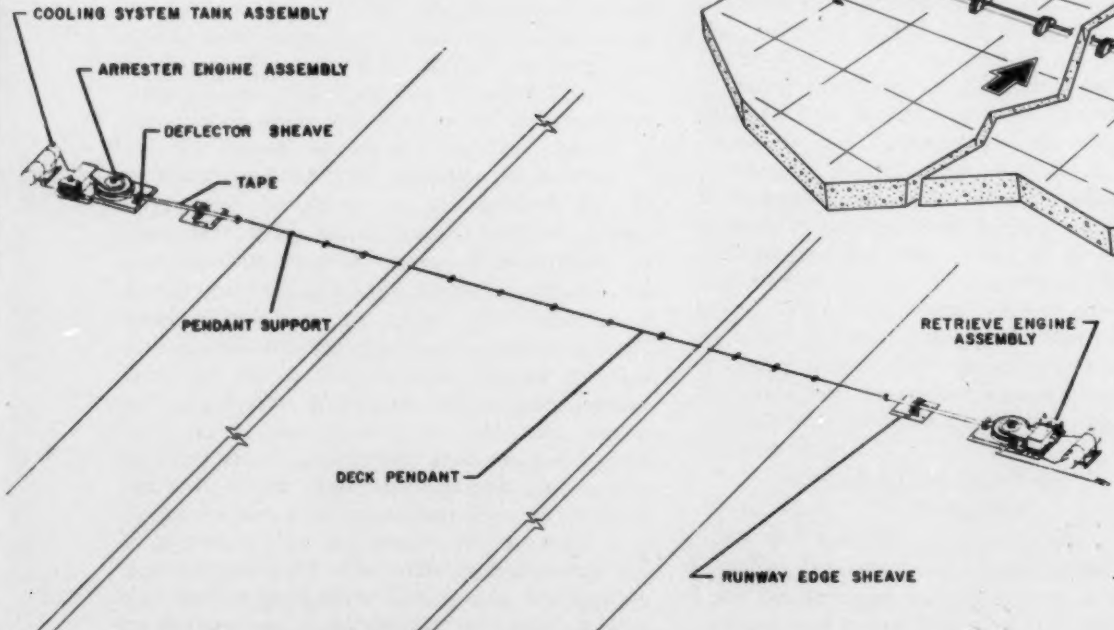


Fig. 3
E-28 Emergency Runway Arresting Gear Installation
(Bidirectional)

C24-P1-971

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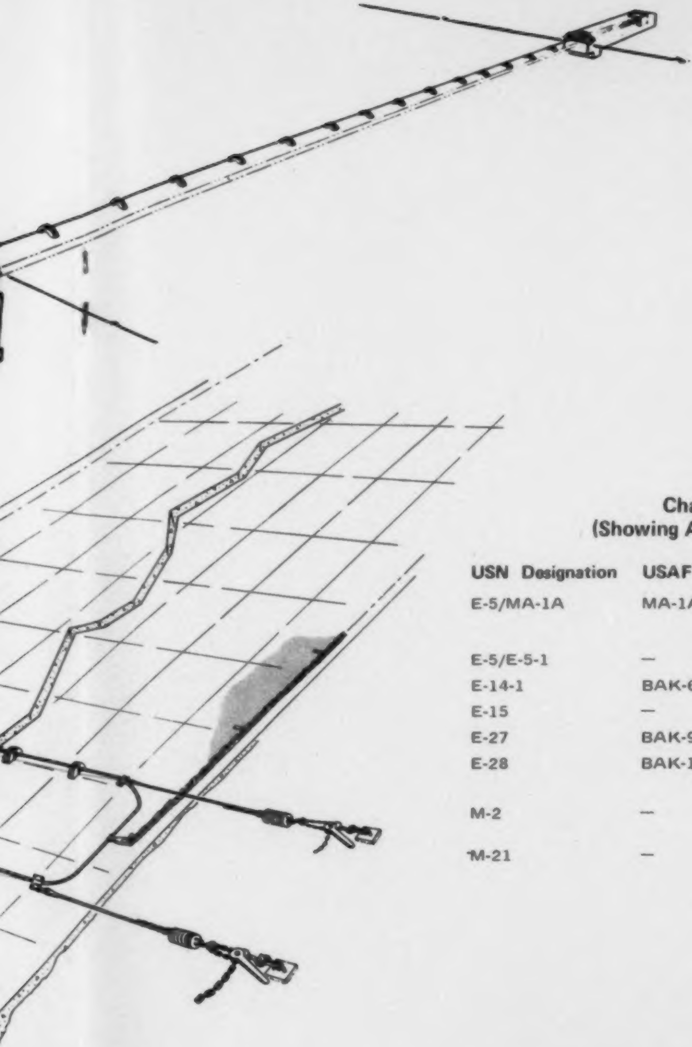

Fig. 4
5 Field Emergency Chain Arresting Gear

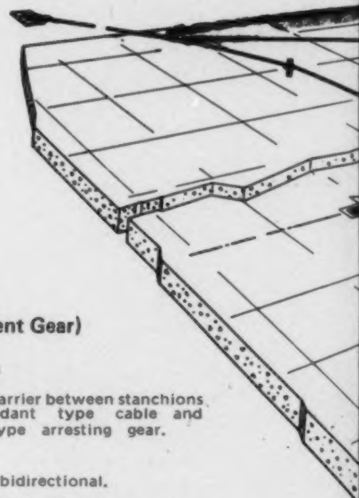

Chart of U.S. Navy Arresting Gear
(Showing Air Force Designations of Equivalent Gear)

USN Designation	USAF Designation	Remarks
E-5/MA-1A	MA-1A (modified)	Unidirectional, nylon barrier between stanchions combined with pendant type cable and attached to chain type arresting gear.
E-5/E-5-1	—	Chain type.
E-14-1	BAK-6	Water-squeeze type, bidirectional.
E-15	—	Two E-27 A-gears, bidirectional.
E-27	BAK-9	Rotary friction brake, bidirectional.
E-28	BAK-13	Rotary hydraulic, bidirectional.
M-2	—	Morest (2 hydraulic units), bidirectional. (May be installed on a permanent basis.)
M-21	—	Rotary hydraulic operational arrestor, short runout, bidirectional.

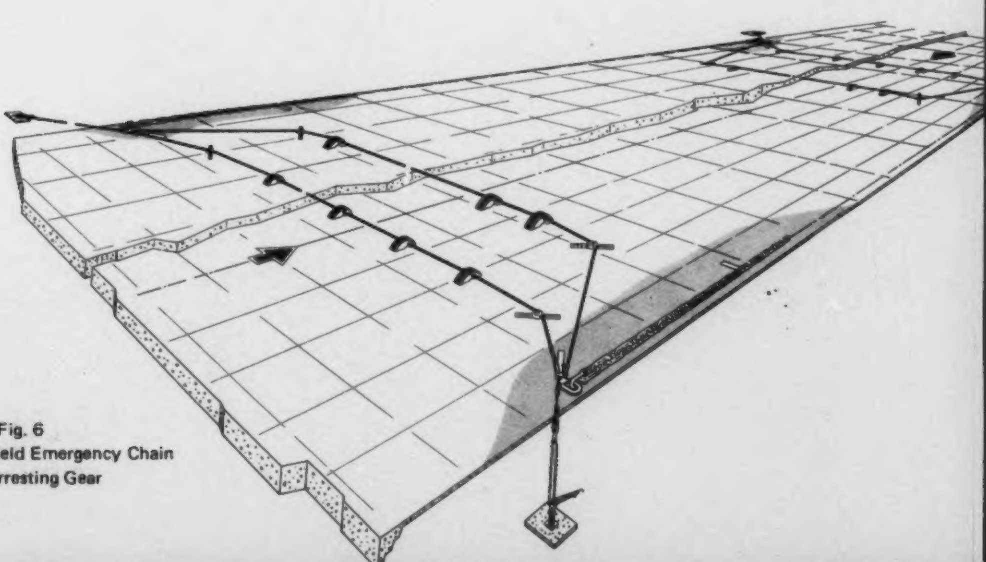

Fig. 6
E-5 Mod 1 Field Emergency Chain Arresting Gear

Emergency Field

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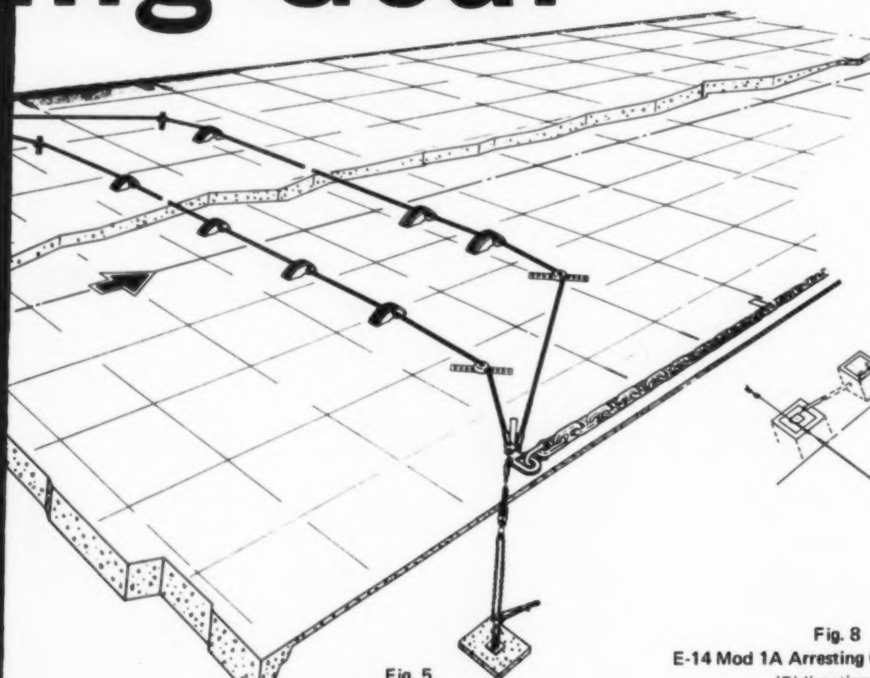

Fig. 5
E-5 Mod 1 Field Emergency
Chain Arresting Gear

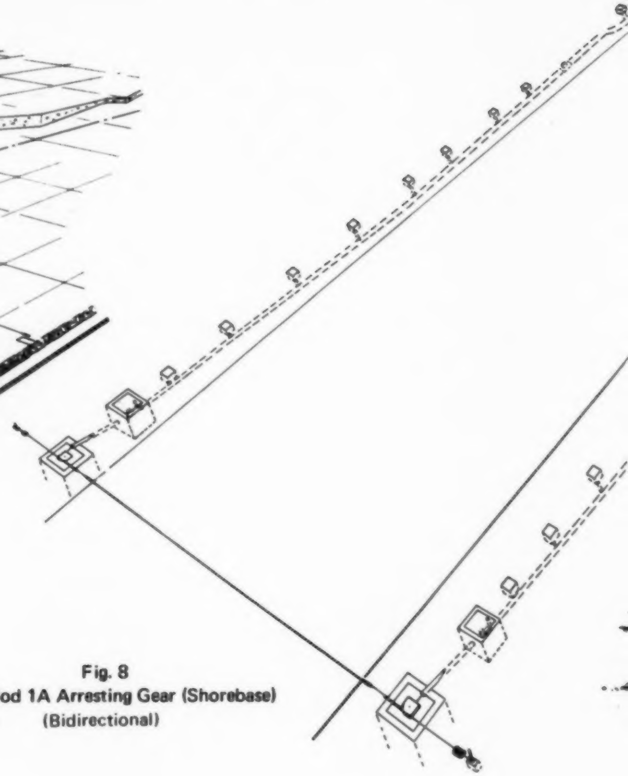

Fig. 8
E-14 Mod 1A Arresting Gear (Shorebase)
(Bidirectional)

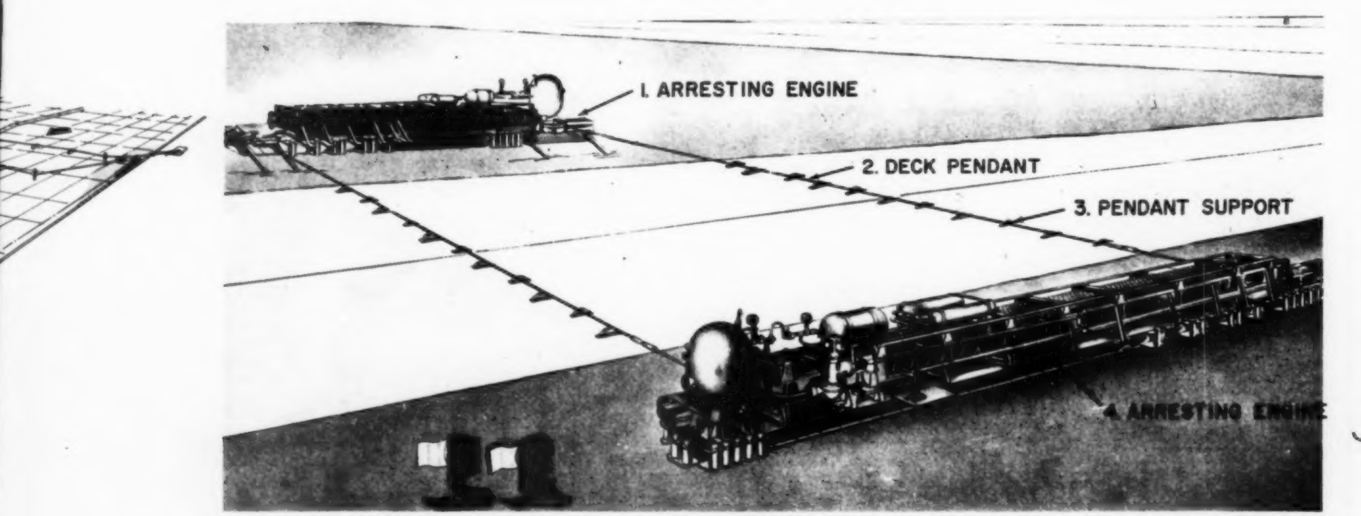

Fig. 7
M-2 Expeditionary Arresting Gear, General Arrangement (Bidirectional)

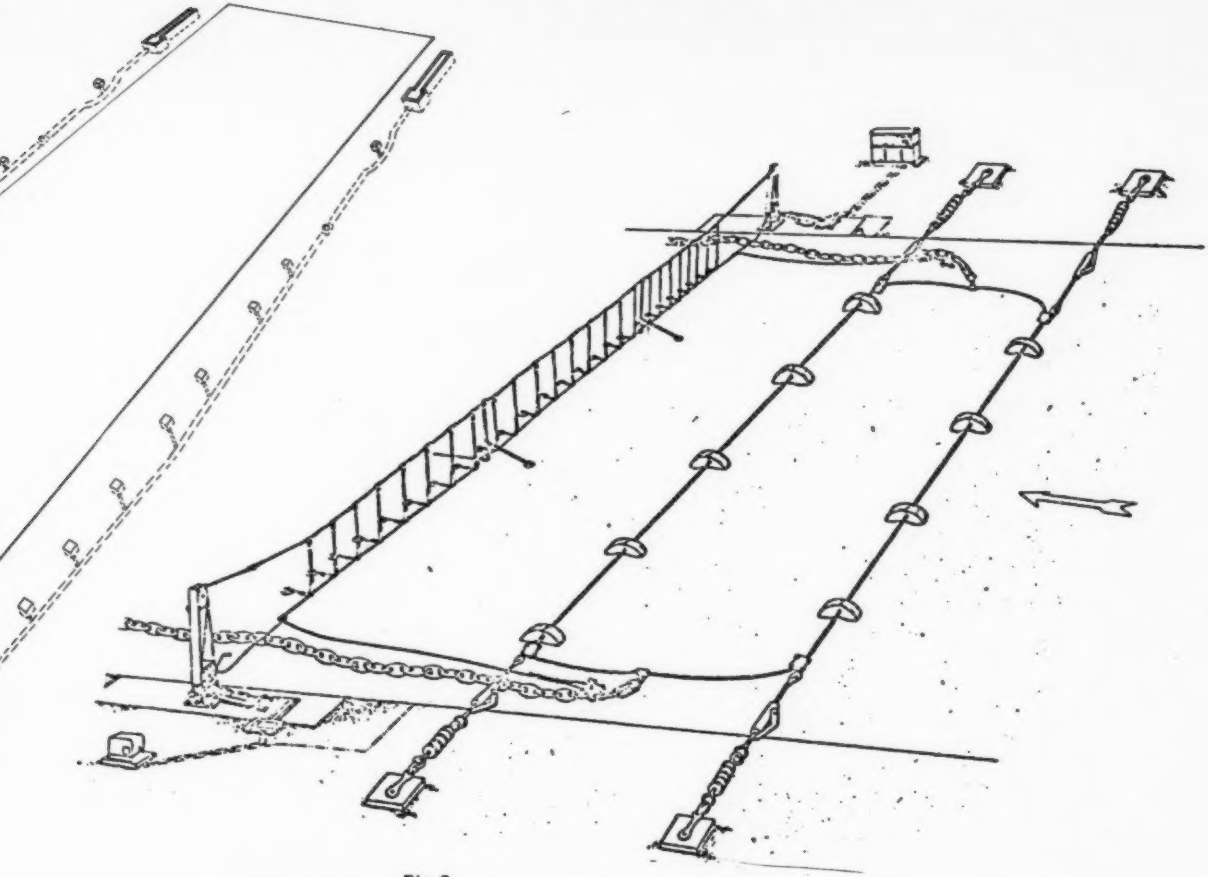

Fig. 9
Type MA-1A Runway Overrun Barrier combined with Pendant Type Arresting Gear

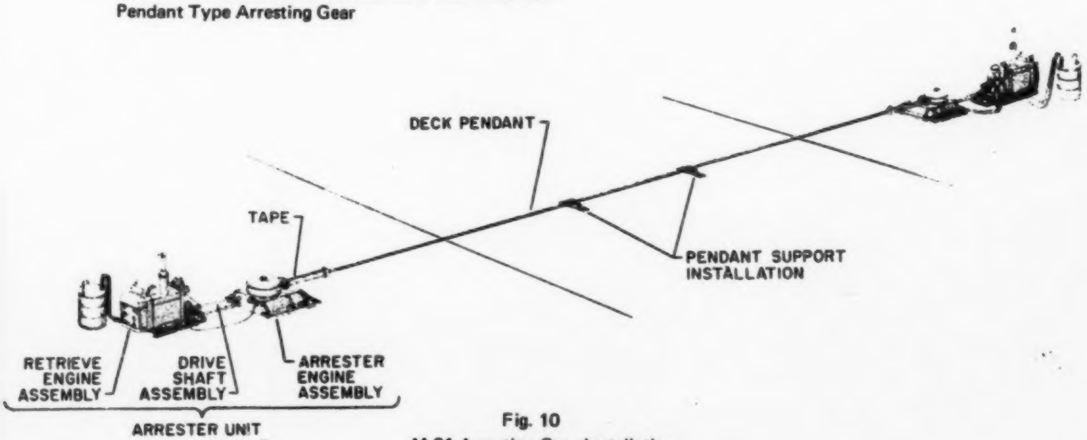

Fig. 10
M-21 Arresting Gear Installation
(Bidirectional)

See article "Arresting Gear" on page 23 of the October 1971 APPROACH.

Prepared by
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Naval Air Station
Norfolk, Virginia 23511

weights are arranged so that the heaviest chain is in the middle. Normally only one pair of cables may be rigged at a time, depending on the desired direction of arrestment.

The E-5 and E-5-1 emergency chain arresting gear usually has two (dual) arresting cables. The difference between the two installations is that the E-5 has a dual "straight" pendant while the E-5-1 has a dual "shaped pendant" (Figs. 4 and 5).

The principle of operation for both the E-5 and E-5-1 is that the arresting cable, when engaged by the aircraft arresting hook, transmits the energy of the aircraft to the two anchor chains. The arrangement of the chains allows them to pay out gradually, progressively increasing the weight pickup. The energy is dissipated by the gradual pickup of the chain weight until the arrestment is completed.

The E-5-1 emergency chain arresting gear may be combined with the MA-1A barrier in certain installations. In this case the installation will be referred to as the E-5/MA-1A. It is noted that this designation is roughly equivalent to the Air Force designation MA-1A (modified).

M-2 Arresting Gear

The M-2 expeditionary arresting gear, originally developed for Marine Corps use (Fig. 7) is a mobile type arresting gear that can be installed on a small landing strip for safe and efficient arrestment of aircraft. (Note: This gear may also be installed on a permanent basis.)

The M-2 uses hydraulic pressure for the absorption of energy of the landing. Two hydraulic arresting engines are used for each installation with one engine being installed on each side of the runway. Both engines are reeved with wire rope cables and two wire rope deck pendants are run across the runway between engines.

To transport the M-2 arresting gear from place to place, each arresting engine is provided with a detachable fore and aft undercarriage and a detachable stand. The trailer platform is the platform on which the arresting engines are mounted. When the platform is mounted on undercarriages the entire unit becomes a trailer which can be moved overland. When the gear is subsequently installed at another site the undercarriages and stand are removed.

E-14 Arresting Gear (Shorebased)

The E-14 arresting gear (Fig. 8) is designed as an emergency standby gear for arresting tailhook-equipped aircraft. It may also be equipped with a barrier for arresting other jet aircraft.

It is designed to arrest tailhook-equipped aircraft up to 50,000 lbs in weight and at engaging speeds up to 160 knots. Within these limitations the aircraft will be halted within a 1000-foot runout. Engagements may be safely made at up to 50 feet to either side of the runway centerline.

The E-14 works on the water-squeeze principle in which four loosely fitting pistons, equally spaced at the end of the purchase cable, are pulled through a tapered (stepped) tube. A portion of the tube is filled with fluid. As the pistons move toward the smaller end of the fluid-filled portion of the tube, the annular orifice between the pistons and the tube diminishes; the resulting hydraulic pressure retards the travel of the pistons until they are brought to a halt.

Two modifications of the E-14 (Mod 1A and Mod 1B) both accomplish essentially the same purpose: provide a greater arresting capability and more leeway for off-center engagement.

E-5/MA-1A Arresting Gear/Jet Barrier

The E-5 arresting gear, already described, is combined in certain installations with the MA-1A jet barrier (Fig. 9). The barrier consists of nylon webbing which, when engaged by an aircraft nosewheel, raises a cable to catch the aircraft's main landing gear. The cable then pulls out links of heavy anchor chain until the weight of the chain brings the aircraft to a stop.

In the arresting gear/jet barrier combination installation the anchor chain is repositioned to be even with the pendant cable so that the tailhook-equipped aircraft will start dragging chain as soon as it hooks the pendant. By positioning the pendant about 35 feet in front of the barrier, the tailhook will begin to drag chain before the webbing and main cable become entangled with the landing gear.

The E-5/MA-1A installation is also capable of arresting some hookless jet aircraft; however, it is effective only with certain aircraft with tricycle landing gear of proper geometry, adequate ground clearance and, as a general rule, without external stores.

M-21 Arresting Gear

The M-21 (Fig. 10) is a bidirectional expeditionary recovery system designed for use in SATS (short airfield for tactical support) applications. Recently this system has also been employed as an emergency arresting system at Marine Corps air stations. As required for SATS use, the M-21 is a rapid cycle gear that consists of twin arresting units, one on each side of the runway, each of which contains a horizontal drum of nylon tape with a connector at the free end. The connectors are joined by a length of steel cable, which is stretched across the runway and held in a raised position by wire supports for engagement by tailhook-equipped aircraft.

Arrestment by the M-21 depends upon the ability of the energy absorber unit to gradually stop the unwinding of the tape. The energy absorber unit contains a vaned

rotor that revolves within pressurized fluid as the tape unwinds, thus creating turbulence in the fluid and thereby providing the arresting action for the system. Included in the unit is a throttle which is set as required for aircraft weight before each arrestment. (Present plans for use of M-21 as an emergency system involve establishing a single, optimum throttle setting.) Power for retraction of the system to the battery position is supplied by a diesel retraction engine.

Summary

Emergency field arresting gear has proven to be a valuable aid in the prevention of aircraft accidents. Pilots should familiarize themselves with the type gear in use at fields where they operate. The current IFR enroute supplement and applicable instrument approach plates should be consulted in order to determine the type and location of emergency field arresting gear at specific fields.

Chart of U.S. Navy Arresting Gear (Showing Air Force Designations of Equivalent Gear)

USN Designation	USAF Designation	Remarks
E-5/MA-1A	MA-1A (modified)	Unidirectional, nylon barrier between stanchions combined with pendant type cable and attached to chain type arresting gear.
E-5/E-5-1	–	Chain type.
E-14-1	BAK-6	Water-squeeze type, bidirectional.
E-15	–	Two E-27 A-gears, bidirectional.
E-27	BAK-9	Rotary friction brake, bidirectional.
E-28	BAK-13	Rotary hydraulic, bidirectional.
M-2	–	Morest (2 hydraulic units), bidirectional. (May be installed on a permanent basis.)
M-21	–	Rotary hydraulic operational arrestor, short runout, bidirectional.

Chart 1

Aircraft Recovery Bulletins Pertaining to Emergency Field Arresting Gear

The tabulation below relates current ARBs to the various types of emergency field arresting gear. Pilots and other operations personnel should be familiar with the contents of applicable ARBs for the most effective use of emergency field arresting gear, particularly as they pertain to engagement speeds, weights and limits of off-center engagement.

ARB Application	Applicable ARB
E-5 and E-5 Mod 1 Emergency Arresting Gear (150 to 500-foot span)	**47-12D**
E-14-1 Emergency Arresting Gear	**42-12D**
E-15 Emergency Arresting Gear (300-foot span)	**44-12C**
E-15 and E-15 Mod 1 Emergency Arresting Gear (200-foot span)	**48-12C**
E-27 Emergency Arresting Gear	**43-12F**
E-28 Emergency Arresting Gear (225-foot span)	**46-12C**
M-21 Arresting Gear	**45-12C**

Chart 2

The valuable assistance of NAEC Philadelphia personnel in the preparation of this article is gratefully acknowledged.

BUSTING MINIMUMS

PERIODICALLY, we read or hear about a pilot who deliberately descends below minimums on an instrument approach without having the field in sight. The question always arises as to why a pilot (often very experienced) would deliberately violate such an important safety rule. Frequently, get-home-itis or get-there-itis is the culprit, but there are other sundry reasons.

A recent letter from an APPROACH reader, Mr. Thomas O' R. Gallagher, a civilian pilot examiner, suggests one reason. He writes:

"Why would an experienced pilot go below minimum altitude on an instrument approach? Here's a story told me by one of my former students:

'The mission was not important. We merely wanted to get the oil changed in our aircraft in preparation for a long flight the next day. There were no facilities at our base but we could get the job done at another field 15 miles away. We had nothing else to do, and my copilot wanted some practice in actual IFR conditions, so we launched.

'The ceiling at destination was reported as 500 feet and one mile visibility, right at minimums for that particular approach. I was familiar with the field and knew that we would be passing over terrain with no obstructions. In fact, I knew the terrain well enough to know that we would be passing over a cemetery on final approach.

'We were cleared for the approach. We descended to 500 feet, with the copilot flying. I was handling the radio and trying to see down through the clouds. They were thin in spots and the ground was faintly visible. I called the tower and asked for the latest ceiling estimate. It was still 500 feet. I saw the cemetery for a few seconds but I still could not see the airport. I knew the estimate had to be wrong and I assumed we would have the airport in sight if we went down another 50 feet or so. I told the copilot to go down a little lower.

'The time to start the missed approach came, but I delayed a few seconds while I took a last look around, right, then left, and to the rear. The tower called and said they heard us go by overhead. I acknowledged and announced a missed approach. Finally, I looked at the altimeter and saw that we were down to 375 feet. I now recognized that we were on the far side of the airport and that there were high towers in the area. Fortunately, the missed approach was executed without incident.'

"What is the answer? I'm not sure, but I think these pilots were bored, looking for a little excitement. Most of all, though, I believe it was simply a *lack of self-discipline on the part of the pilots*."

It looks as if Mr. Gallagher has hit the nail on the head. In almost every case we can think of, it all boils down to a lack of self-discipline on the part of the pilot when a descent is made below minimums, *regardless* of the specific reasons which may be advanced.

Instrument approach minimums exist for good and sufficient reasons. The mark of a professional aviator, civilian or military, is to observe them at all times. ◄

The following "gem" is from Legal Eagles News, Vol. XIII No. 10, June 1971, published by the Lawyer-Pilots Bar Association.

Boob-of-the-Month Award

The Organized Flying Adjusters found another gem for March. A civilian pilot and his wife were flying at 1500 feet over Florida when they got into a heated discussion that turned into a full-fledged domestic tiff. The wife grabbed the key from the mag switch and the pilot made a dead stick landing into an orange grove.

MIDAIR collisions continue to be a hazard to safe flight. It is a paradox that some collisions have occurred under visual flight conditions in which the pilots of both aircraft could have seen each other in time to avoid collision – if they had been looking and seeing (whether filed IFR or VFR).

Midair Collision Avoidance

Illus 28-29

There are many reasons for a pilot failing to see another aircraft. Some of the most important ones are discussed below:

• *Cockpit Preoccupation* – A conscious effort to improve pilot instrument scan will greatly reduce time spent looking inside the cockpit. The high closure rates of modern aircraft demand that considerable time be spent looking *outside* the cockpit during visual flight conditions. Crewmembers can greatly assist pilots, particularly if they are properly briefed on how to look, what to look for and how to report targets.

• *Factors Affecting Vision:*

(1) Fatigue – Adversely affects vision by slowing muscular action of the eyes (iris and external muscles).

(2) Glare – Overstimulates the eye and causes loss of sensitivity.

(3) Hypoxia – Results in loss of visual acuity, constriction of visual field and difficulty in focusing.

(4) Space Myopia – Reduces ability of the eyes to focus. Due to the absence of objects to focus on (horizons, clouds), eyes tend to focus at the windscreen or just outside the cockpit; sighting distances are greatly reduced. (Shift gaze frequently to the instrument panel, wingtips and distant objects, if available.)

(5) Brightness/Illumination Inversion – Affects the eyes at high altitude; more light comes from the atmosphere below than from above and floods the eyes, causing the cockpit to appear quite dark in contrast to the outside.

• *Fixation* – A tendency for fixation must be avoided. Scan in sectors; shift gaze vertically as well as horizontally; practice focusing on objects of known or accurately estimable distances, when available. (This aids in avoiding fixation and in earlier detection of airborne targets.)

• *Contrast* – Objects are more easily seen against contrasting backgrounds. In extremely low illumination, objects are detected almost entirely by contrast. Contrast or relative motion are the visual values which will most likely stimulate the eye. In dull skies, total airframe contrast is likely unless its color scheme blends with the background.

• *Reduced Illumination* – Central vision is lost in light values less than moonlight; corner vision must be employed.

• *Positive G Effects* – May reduce peripheral vision.

• *Turbulence* – In extreme cases can cause deterioration of vision. Prolonged flight in turbulence is fatiguing; degrades alertness.

• *Total Reaction Time to Avoid Collision* – Total time required to perceive and recognize an aircraft, become aware of a collision course and decide which

way to turn may vary from as little as 2 to 3 seconds to as much as 10 seconds or more, depending on variables affecting the individual, the types of aircraft involved and the geometry of the closing situation.

- *Sighting Distances* – Frequently as low as 3 miles for jet (attack as well as fighter) aircraft and light planes, and 5 to 7 miles for larger (transport) type aircraft.
- *Aircraft on Collision Course* – When a collision course is recognized (constant bearing) the pilot may not instinctively take the correct action. Turning into the aircraft to break the collision course or changing altitude will sometimes be the best solution. However, in some cases it may increase the hazard. Therefore, all collision situations that can possibly be conceived must be considered and planned for. Finally, evasive action should include maintaining visual contact with the other aircraft, if at all practical.

Don't assume an IFR clearance will provide separation, particularly when flying in and out of clouds or in visual flight conditions. Aircraft can legally fly VFR in one mile visibility outside of controlled airspace.

As it is with any hazard, avoidance of midair collisions is a matter of recognizing the hazard and reducing exposure to it. A great deal of effort has been expended by the military and FAA to develop better rules, procedures and navigation systems to decrease the midair collision hazard.

In June of this year CNO, in an attempt to prevent midair collisions and increase flight safety, directed aviation activities to take the following actions:

- Accelerate to the maximum extent possible the integration of naval air operations into the air traffic control system.
- Conduct all flights in accordance with instrument flight rules to the maximum extent possible without mission derogation.
- Ensure installed CNI (communications, navigation and identification) equipments are operative at takeoff.
- Cooperate fully with the FAA at all levels in an effort to incorporate VFR flight operations within the air traffic control system.

Much can be done by the pilot to avoid this hazard. All pilots must constantly:

(1) Avoid areas of known traffic congestion such as student practice areas and airport approach zones.

(2) File IFR and make maximum use of positive control areas as directed by CNO.

(3) Know the hemispheric rules, particularly as they apply to VFR flying.

(4) Be especially vigilant in the vicinity of navigation aids and terminal areas where a great many midairs occur. The establishment of area navigation routes is expected to improve this situation.

Other local factors may be significant, such as terrain, proximity of airports, primary traffic flows and the availability of air traffic control services. The mix of IFR and VFR traffic, particularly in terminal control airspace, is a real problem. The collision threat here exists between aircraft in transition (climbing, descending and changing speed or configuration) in addition to those aircraft in level flight. Keep in mind that controlling agencies are not always "skin painting" traffic but may be receiving beacon returns only. Also, most light planes are not beacon-equipped and provide only a weak radar return, if any return at all, unless transponder-equipped. Remember, visual flight conditions place responsibility for collision avoidance *on the pilot*, even when filed IFR.

By LCDR J. A. White, MC, USNR-R
Resident in Otolaryngology,
Tulane University School of Medicine

The Common Cold: Respiratory Warning Light

MOST Americans have from one to six colds a year. Although aviation personnel admittedly are a healthy group, they certainly average at least the minimum. And though all aircrewmen know they are not supposed to fly with colds, they often do. In fact, there were 13 major aircraft accidents in a recent two-year period in which the common cold, although not on the manifest, was aboard.

It has all been said before. "Don't fly with a cold." "Colds can kill." Etc., etc., etc. . . . *ad nauseum*. But again we must say it, because flying with a cold continues to be a problem in naval aviation. Although interest in the prevention and treatment of the common cold is second only to interest in sex, much confusion, misunderstanding and false information still exist. Like the weather, everyone talks about it but nobody . . . This article is an effort to refresh and clarify a few facts. Read on (sniff!).

By way of background and interest, a few facts about the common cold are pertinent. The common cold must be separated from its complications for discussion and practical application. The common cold is a viral disease confined to the nasal passages, causing runny nose, nasal congestion and obstruction and, occasionally, sneezing. It is self-limited to 3-5 days *unless* complications occur. Fever, cough and/or sore throat are *not* components of the simple viral cold but are complications caused by a secondary bacterial infection. *Any "cold" with yellow nasal discharge or the above symptoms has developed a secondary bacterial infection.*

The common cold knows no geographic, climatic, seasonal or population limitation. It occurs in humans universally, although sometimes isolated small populations may have fewer colds than average. Colds peak in the fall and spring.

What about the culprit virus? For the medically minded, the cold virus was first isolated in 1914 and by 1960 more than 20 distinctly different viruses were known to cause colds with more being isolated regularly as studies continue. Cold viruses are very small. They can be grown in tissue culture where they prefer slight acidity and a temperature of around 91°F – the precise conditions which exist in the outer nasal passages. Another practical consideration is that all cold viruses are destroyed by heat and/or acidification, *hence the emphasis on sterilization, etc., of coffee cups and other means of preventing cross-contamination.*

How are colds spread? Right on! By direct contact such as the coffee cup or the kiss or by indirect air droplet transmission – the classic sneeze-from-the-schnozz. The victim of a cold is contagious usually from a few hours before onset of symptoms and then for about two days, although some individuals may become carriers of the virus for several weeks even in the absence of symptoms. Your buddy, the self-sacrificing good sport who reports to work with a cold, is doing you no favor. He not only spreads "the bug" around liberally but also prolongs his own disability by not getting the only known effective treatment for a cold – rest. In addition, he increases his chances of a secondary bacterial infection and possible complications. More on this later.

Immunity to a given cold virus develops rapidly after symptoms begin, which is the reason for the relatively short duration of the simple viral cold. Immunity lasts, perhaps, for a month. However, with so many different cold viruses around, it is easy to get a cold every several weeks. Now, what about the lucky guy who never seems to have a cold? Natural immunity does exist, probably related to high levels of *interferon*, a potent anti-viral protein found only in a fortunate few, unfortunately. But for us unlucky masses of cold-sufferers, there is some resistance to the virus. Although exposure to sudden changes of temperature,

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chilling and dampness absolutely does not cause a cold, it certainly can lower resistance to the cold virus which is, no doubt, lurking nearby. Fatigue is another important predisposing factor. So . . . adequate rest, balanced diet, proper exercise, etc., are certainly in order!

About treatment: Is Great-Grandmother Hazel's Horseradish Pack effective? Is Minnie's Mystic Mist any good? Nobody knows. But do get plenty of rest, preferably in bed for a day or two, not only "for the cure" but to prevent spreading the bug to others as well. Drinking plenty of fluids is also helpful. A word of caution: Remember that, although great-granny's cure may be wonderful, great-granny didn't fly airplanes. Flying and self-medication don't mix! Obtain proper medication through your flight surgeon.

Now about the distinction between the simple viral cold and its complications. Without the complications, the simple cold is usually a minor nuisance (unless carried to altitude). However, complications are the rule rather than the exception and thus the frequent medical term "URI" (upper respiratory infection) implies more than just a simple cold. Most common colds or URIs usually include mild fever, sore throat, cough and at least some pus in the nasal discharge. If these complications aren't sufficient, you can also develop sinusitis, otitis media, mastoiditis, meningitis, osteomyelitis, brain abscess and pneumonia – *all* from the secondary bacterial infection invited into your body by the virus. It certainly doesn't make good sense to encourage complications by flying, now does it? And, incidentally, pure oxygen has a marked drying and irritant effect on the respiratory mucosa which is much worse if the mucosa is already sick.

Although "virus" in a ground-pounder may be simple, in the aviator VIRUS spells:

- *V*ertigo
- *I*nfection
- *R*upture (eardrum)
- *U*nexpected pain
- *S*inus block

These are obviously all incompatible with safety of flight. Aviation and respiratory infection do not mix. "URI" in the aviator spells: *U*nexpected *R*eal *I*ncapacitation.

But let's be practical, you say. Mission commitment requires so many sorties and hops just have to be flown no matter what. Besides, "deployment is next month" or "safety standdown was last month" or "the skipper said such-and-so the other day" . . . training requirements this . . . proficiency that . . . whatever the reason, there always seems to be some urgent need to

launch the bird. Fine. After all, what else is this business all about? Press on!

"Of what importance is a little sniffle compared to the CAG's squadron readiness evaluation? I'll just ignore this sore throat/cough/ear fullness until after this at-sea period/carquals/fitness report. Besides," you croak, "being sick implies weakness.[1] An aviator is supposed to do anything, anytime, anywhere. I'll never make admiral/LCDR/LTJG, with a down chit in my record. Etc., etc., etc. . . . " (Did we say *ad nauseum*?)

Sure . . . nobody likes to be sick. Everyone wants a good record. But consider what your record will look like with an accident report. "Pilot error, pilot error, pilot error!!!" chorus the accident board and all subsequent endorsers. Or worse, what if you get the proverbial "BFD," the Big Final Disease?

That's why the Old Doc, the squadron ASO and all the other safety types keep harmonizing that old refrain, "Don't Fly With a Cold." Your flight surgeon is definitely interested in keeping you flying, but safely! He regularly sees the consequences of ignoring a cold. Would you fly a bird with a fire-warning light on turnup? Probably not. Maybe there is no fire and only the light is faulty. But then again, why take the chance? Consider this: The symptoms of a cold are a "Respiratory Warning Light." Why take the chance?

(For those aviators who fail to follow repeated warnings relative to flying with colds, it might behoove their CO to exercise some command attention in their direction. After all, the CO stands to lose too. – Ed.)

[1] For development of this idea see "Manhood vs. Safety" on p. 20 of the June 1971 issue of APPROACH.

ALTERNATE STARTING

If it doesn't work as advertised, something must be wrong with it. DON'T SHORTCUT!

INVESTIGATION of a recent A-4C aircraft accident, which occurred during takeoff, revealed a cause factor directly attributed to first-stage turbine stator failure of the aircraft's J65-W-20 engine.

Approximately 25 percent of the first and second-stage stator vanes had burned or broken away between the 8 and 11 o'clock positions in the vane assemblies. This thermally-induced failure precipitated catastrophic mechanical failure of the turbine rotor. Successful ejection by the pilot was accomplished at 150 feet AGL. The aircraft crashed on the runway and came to rest in the overrun area.

NAVAIREWORKFAC Quonset Point message 071719Z of July 1971 reported the results of functional accessory testing and laboratory analysis following engine disassembly. The only discrepancy noted was a small amount of phrenolic resin-type contamination found in the No. 5 fuel distributor slider valve. This contamination is believed to have caused intermittent sticking of the valve which supplies fuel to the failed turbine stator area.

A review of the maintenance history of this engine revealed the following significant information:

(1) The engine had accumulated 81 hours since overhaul and conversions to J65-W-20.

(2) Four different pilots had reported discrepancies while attempting to start the engine. Three cases of multiple wet starts occurred within the month previous to the crash. To overcome the wet start problem the last two pilots used the airstart switch to effect a lightoff since the maintenance troubleshooters could not duplicate or correct the problem.

It is concluded that the sticking fuel distributor valve most likely caused an overfueling condition during the unsuccessful starting attempts which resulted in wet starts. By overriding the automatic ignition cut-out feature with the airstart switch, the pilots were able to effect a lightoff *but paid the penalty of cumulative thermal damage to the turbine stator vanes.* Since the most severe damage was found midway between the 9 and 12 o'clock position thermocouples, it is likely that the overtemperature would not have been displayed in the cockpit.

It is recommended that:

(1) All J65-16/20 operators refrain from using the airstart switch for any purpose not specifically outlined in NATOPS.

(2) Maintenance troubleshooting procedures be strictly adhered to as outlined in the appropriate service instruction handbook, especially in cases of seemingly incorrectible repeat discrepancies.

Failure of Mk-2 Life Preserver CO_2 Cylinders

EXPLOSION of a CO_2 cylinder (FSN 9C 4220-287-3740) in a Mk-2 life preserver, lying on the deck of an aircraft near a heater duct, has been reported by a squadron. The UR (unsatisfactory report) states that the explosion ruptured all three lifevest compartments around the area of the vest inflation assembly. The exploding CO_2 cylinder was subsequently found to be scored. Furthermore, 40 out of 160 similar cylinders examined also had score marks.

These CO_2 cylinders are designed to withstand hydrostatic pressures of 7000 psi without failure. When charged and at room temperature, the cylinders contain internal pressures of approximately 900 psi with overcharging producing slightly higher internal pressures. To test for proper charging and cylinder structural integrity, specification MIL-C-601 requires that each filled cylinder be subjected to an elevated temperature of 160°F. This test subjects the completed assemblies to near bursting pressures with the requirement that there be no deformation or destruction of the cylinder.

The Naval Air Development Center advises that steps have been taken with respect to this problem:

1) NAVAIR 13-1-6.1 (Aviation-Crew Systems Manual: Inflatable Survival Equipment) is being changed to incorporate the requirement for physical inspection of all CO_2 cylinders *before* they are put in life preservers.

2) Defense contract administration personnel have been requested to review their inspection procedures to prevent acceptance of defective cylinders in current and future contracts under MIL-C-601.

Additionally, all personnel are urged to spread the word that survival equipment with CO_2 cylinders must not be stored or placed anywhere near excessive heat.

Save Face

IN a helicopter accident, the pilot wearing the SPH-3 helmet pictured above suffered only sore muscles. The aircraft came to rest on the left side with the airframe structure caved in very near the pilot's head. (He was still strapped in the cockpit seat.) At final impact, the pilot's head probably dropped forward and struck the airframe. The helmet visor absorbed the force and saved his face – probably preventing serious and permanent injury. This is another good example of how proper use of flight gear can save a pilot to fly again.

LCDR R. F. Frontz
ASO, HT-8

Personnel-Lowering Device

EVERY so often a naval aviator or crewman makes an emergency parachute descent and hangs up in a tree. This can be a real problem in the jungles of southeast Asia.

For some years the Air Force has had a personnel-lowering device but the Navy, with its different types of aircraft and parachutes, had not come up with a satisfactory workable solution to the problem until just recently. Thanks to Eugene V. Ingram, a civilian instructor at FAETUPAC's SERE (Survival, Evasion, Resistance and Escape) School, the Navy now has a practical, compatible *design* for such a lowering device. Mr. Ingram devised a special pack tray and container making the Air Force device useable with Navy aircraft and parachute systems. Tested by VF-114 and VF-121 at NAS Miramar, the rig has been authorized for use in the F-4, F-8, A-4, A-7, RA-5C and OV-10 aircraft.

Briefly, the aviator attaches the device to his entangled parachute, disconnects himself from the parachute and safely lowers himself to the ground.

notes from your flight surgeon

Disadvantaged Situation

AFTER ejecting on a dark moonless night, a pilot, along with his seat pan and liferaft, became tangled in shroudlines. He could not locate his shroudcutter which he had recently moved to a new location on his survival vest. He became tangled in the first place because he could not find his koch fittings in the dark.

By releasing his seat pan and oxygen hose, he managed to free himself. However, when the rescue helo approached the area he could not find his Mk-13 Mod 0 signals. He waved his flashlight and a rescue swimmer entered the water. Once in the water, the swimmer apparently could not tell which light belonged to the pilot and swam towards some light markers. Meanwhile, the pilot found a Mk-13 Mod 0 signal and ignited it, attracting the attention of both the swimmer and the helo crew. The swimmer then hooked both his and the pilot's D-rings to the helo hoist and they were hoisted aboard.

Back aboard ship, when presented with his intact survival vest in a well-lighted room, the pilot located his shroudcutter only after considerable searching, investigators said.

"Further comment is needed on the difficulties experienced with the pilot's survival equipment," the investigating flight surgeon stated. "The survival episode was actually a continuous and many times unsuccessful search for various items of survival gear. All pilots should be thoroughly familiar with the location of every item of survival equipment. They should realize that the relative positions of many items change following ejection forces, life preserver inflation and water immersion. Pilots should review the location of the contents of the survival vest at regular and frequent intervals and prepare themselves to locate items under the most disadvantaged situation."

Gloves

A PILOT, following rescue after a midair collision, had some kind words to say about his nomex gloves. Water temperature was 55°F and air temperature 66°F. He was in his raft for two hours before being rescued.

"I took my gloves off only once," he reports. "This was when I was opening the pouches on my SV-2A survival vest and feeling for the day-night flares. I couldn't find the edge of the zipper with my gloves on so I took them off until I opened the zippers. Then I put them back on. The gloves really didn't present any problem at all. I would leave them on again."

The copilot took his gloves off and threw them away because of reports that the gloves can interfere with the release of koch fittings. Even after the accident he maintained that he would do the same thing again. Unable to deploy his own liferaft, he shared the pilot's. When he joined the pilot in his raft after an hour in the water he was experiencing leg cramps, his hands were cold and stiff and he was near exhaustion. The investigating flight, surgeon was of the opinion that had the copilot remained in the water much longer he would certainly have been incapacitated and unable to aid any rescue efforts in his direction.

This survival episode typifies the Fleet's feelings pro and con about nomex flight gloves. As noted in the July 1971 APPROACH, the Naval Air Development Center has advised that a silicone-treated glove is on the way. Hopefully, this will eliminate the problem of slipperiness, once the glove is wet. Considering the protection that nomex gloves offer against fire and cold, flying with gloves still makes sense to us. If you remove your gloves, as did the pilot described above, save them as he did and put them back on.

Survival Notes

AFTER 30 to 45 minutes in his raft in 76°F water, an A-7 pilot was picked up by a *Jolly Green Giant*. Except for being cold, he had no complaints. His "survival notes," passed along by the investigating flight surgeon, can easily be applied to any ejection or bailout situation:

"1) Be prepared to release your chute but be careful with the fittings – it is extremely easy to misjudge altitude from a parachute.

"2) A radio is invaluable but it must be tied on. The swells were seven to eight feet and frequently broke over me in my raft and knocked the radio out of my hand.

"3) Retain your hardhat. I bumped my head several times on the helo.

"4) Use the straps on the sling or penetrator. The swells were so high that I was jerked out of the water and dunked into the water several times. Oscillation on the hoist was severe."

'Nuff said. – Ed.

✓ Fog.

maps also 36-39

AN A-7 squadron was scheduled for a carrier refresher and weapons training exercise on a CVA off the West Coast. However, weather at homebase was generally poor and it was necessary for a number of pilots and aircraft to deploy to another West Coast air station in order to get the required FMLP (field mirror landing practice) prior to flying aboard. Unfortunately, the weather at the deployment base also turned out to be somewhat less than ideal.

On the night preceding the planned carrier refresher work, local ground fog prevented commencement of flight operations until just prior to 2200 local when the visibility increased to four miles. One aircraft was launched into the landing pattern to check tower-to-aircraft visibility which proved satisfactory. Five pilots then manned their aircraft and entered the FMLP pattern under control of the air wing LSO, on a frequency monitored by the tower.

As the MLP continued, the pilots became aware of a fog bank forming on the western (seaward) perimeter of the field. One pilot reported this condition to the tower as he turned downwind. The tower concluded that the fog bank had formed to an extent requiring termination of flight operations and, following a short discussion with the LSO, all aircraft were ordered to make final landings. The tower and LSO agreed that each aircraft

would switch to primary tower frequency as they turned downwind from their last mirror landing.

The first A-7 landed and encountered fog during rollout but successfully turned off the 12,000-foot-long runway at the 2000-foot-remaining marker. The second *Corsair* landed on speed just beyond the mirror and encountered fog at about 5-6000 feet from the end of the runway. He had landed near the centerline but soon found that only the lights at the edge of the runway (immediately adjacent to him) were visible. He immediately informed the tower that he was *not* clear of the runway and was unsure of his position. Meanwhile, A-7 No. 3 had touched down on the left side of the runway and, hearing the transmission, began hard braking. The pilot of the third A-7 then transmitted instructions for the aircraft behind him (A-7 No. 4) to use the center of the runway as he was rolling out on the left side. A-7 No. 4 touched down on the centerline. He used aerodynamic braking until the nose fell through at 100 knots, then applied light to moderate braking as he entered the fog bank.

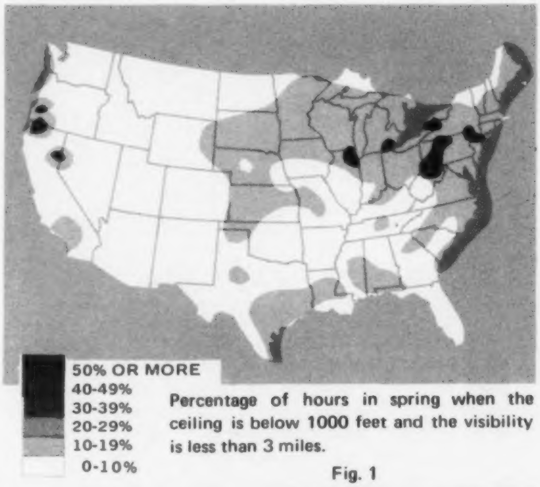
As aircraft No. 3 was passing the 4000-foot-remaining marker at a slow speed, he was overtaken on the right side by the fourth A-7 who was moving at an estimated 60-80 knots. The pilot of A-7 No. 4 had seen the lights of A-7 No. 3 only an instant before passing him. He then commenced heavy braking and attempted to steer to the left side of the runway. However, before he could stop, he collided with the left quarter of A-7 No. 2 at an estimated speed of 40 knots. The right wing of A-7 No. 4 contacted the tail section of A-7 No. 2, pushing the aircraft into an arcing turn to the right. A-7 No. 2 stopped with the nosewheel just off the right side of the runway. A-7 No. 4 stopped just to the left of the centerline. One of the pilots notified the tower of the collision and both pilots quickly secured their engines and evacuated the aircraft. Neither pilot was injured but both aircraft received substantial damage.

Meanwhile, A-7 No. 3 came to a stop and A-7 No. 5 (turning final) landed on a parallel runway. The field was then closed while the runways were cleared. This proved to be a difficult task as the fog, by then, was so thick that visibility was reduced to 20 feet at times.

This accident illustrates to some extent the insidious nature of fog. That is, in the right set of atmospheric conditions, fog can form very quickly, making landings and takeoffs extremely hazardous, if not impossible.

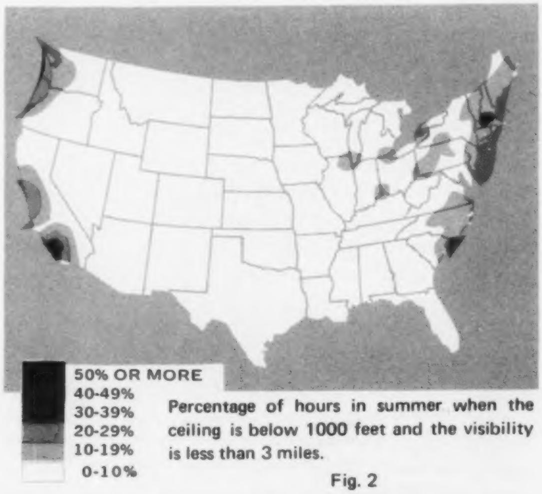
Fog is a year-round phenomenon in many parts of the United States but is generally more prevalent during the colder months. Since winter is rapidly approaching, it may be worthwhile to review some of the basic information about what fog is and how it forms.

Fog is one of the most common and persistent



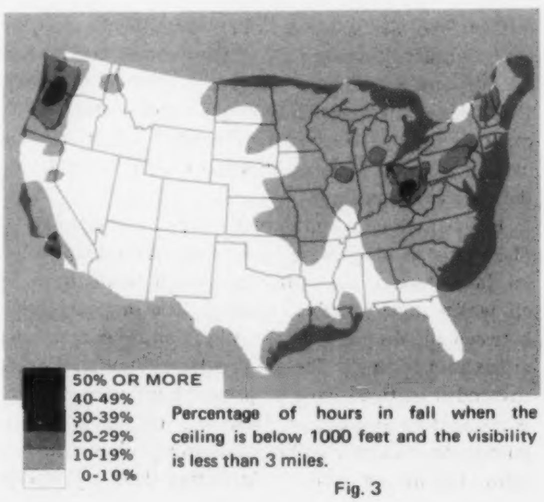
Percentage of hours in spring when the ceiling is below 1000 feet and the visibility is less than 3 miles.

Fig. 1



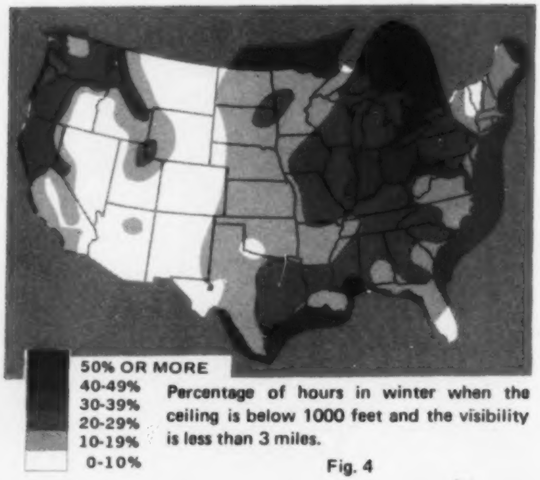
Percentage of hours in summer when the ceiling is below 1000 feet and the visibility is less than 3 miles.

Fig. 2



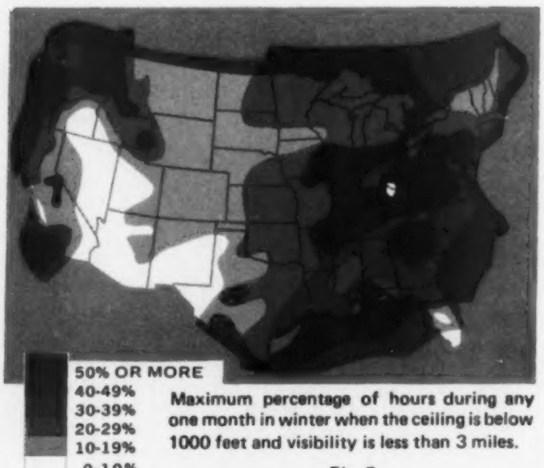
Percentage of hours in fall when the ceiling is below 1000 feet and the visibility is less than 3 miles.

Fig. 3



Percentage of hours in winter when the ceiling is below 1000 feet and the visibility is less than 3 miles.

Fig. 4



Maximum percentage of hours during any one month in winter when the ceiling is below 1000 feet and visibility is less than 3 miles.

Fig. 5

weather hazards encountered in aviation. Since it occurs at the surface, it is primarily a hazard during landing and takeoff and is the most frequent cause of prevailing visibilities below three miles. Flight visibility above fog is generally good. Figures 1 through 5 illustrate the incidence of fog in the continental United States during the various seasons.

Fog is a cloud composed of either water droplets or of ice crystals (depending on the temperature) which lies on the surface of the earth. Since fog normally forms in air which is very stable, there is little or no collision between the droplets or ice crystals, and these particles are extremely small. Therefore, a large number of these suspended particles must be present before the visibility is reduced to any extent. However, fog which is dense enough to restrict visibility to a mile or less can form quite rapidly – a gradual thickening does not always occur. An example of this is the sudden increase in fog density that often occurs shortly after sunrise.

Ideal atmospheric conditions for the formation of fog are high relative humidity (small temperature/dewpoint spread), an abundance of condensation nuclei, light surface wind and some cooling process to start condensation. Fog is, therefore, more prevalent in coastal areas where moisture is more abundant. Even when the relative humidity is less than 100 percent, it is persistent in industrial areas, where products of combustion provide a high concentration of condensation nuclei. Fog occurrences on the whole are more frequent in the colder months, but the season and frequency of occurrence may vary from one area to another.

Fog may form (1) by cooling the air to its dewpoint, or (2) by adding moisture to the air near the ground. Names of various fogs are based on the way they are formed. In many cases, more than one process is operative at the same time.

• *Radiation Fog.* Since it forms as a result of radiational cooling of the ground on clear, calm nights, this type of fog is also widely known as "ground fog." The ground cools the air in contact with it to the dewpoint temperature. Radiation fog is restricted to land areas because water areas do not have much daily variation in temperature. It forms almost exclusively at night or in the early morning and usually disappears within a few hours after sunrise.

Light wind up to about five knots produces a slight mixing of the air, which tends to deepen the fog by spreading the cooling through a deeper layer. Radiation fog usually is very shallow where there is no wind flow.

• *Advection Fog.* This type of fog forms when moist air moves over colder ground or water. Very common along coastal areas, it is often called "sea fog" when occurring at sea. It can also form concurrently with the production of radiation fog. Advection fog usually deepens as the wind speed increases up to about 15 knots. Winds much stronger than this lift the fog into a layer of low stratus.

The West Coast of the United States is quite vulnerable to advection fog. This frequently occurring fog forms offshore, largely as a result of very cold water from the ocean depths rising to the water surface, and is carried inland by the wind. (Reference the A-7 narrative.)

Water areas in northern latitudes have frequent sea fogs in summer. These water areas do not change very much in temperature from season to season, but moist tropical air moves farther north in summer. Fog forms as a result of cooling of the tropical air from below.

Advection fog over the southeastern United States and along the Gulf Coast results from moist tropical air

moving over cold ground. It is, therefore, more frequent in winter than summer.

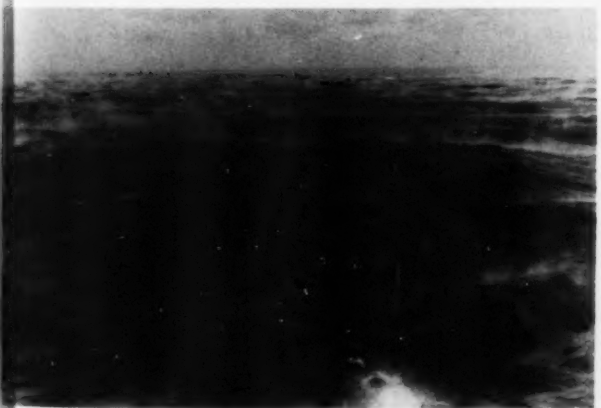
• *Upslope Fog.* This fog forms as a result of moist, stable air being cooled by forced ascension up a sloping land surface. An upslope wind is necessary not only for its formation but also for its continued existence. If the wind becomes strong, the fog lifts and becomes low stratus clouds. Upslope fog is common over the eastern slopes of the Rockies and somewhat less frequent east of the Appalachians.

• *Steam Fog.* The movement of cold air over much warmer water causes intense evaporation. This usually adds enough water vapor to the cold air to saturate it, and fog forms. Steam fog rises from the water surface like smoke, and it is sometimes referred to as "sea smoke."

Since steam fog, unlike advection fog, forms over a warm surface, heating from below tends to make the air unstable. Therefore, turbulence and icing are often encountered in this type of fog.

Steam fog is sometimes observed over rivers and lakes in the middle latitudes in autumn – the water surfaces cool much more slowly than land and are still relatively quite warm compared to an invading cold air mass. It occurs frequently in the winter over open bodies of water in polar regions.

• *Precipitation-Induced Fog.* This fog is caused by the addition of moisture to the air through evaporation of rain or drizzle. Evaporation can occur both when the precipitation is falling through the air and after it reaches the ground. Most frequently associated with warm fronts, this fog may form sometimes with cold and stationary fronts. Other factors being favorable, it can occur with non-frontal as well as frontal precipitation. When associated with a front, precipitation-induced fog usually forms rapidly, covering a large area, especially when it accompanies warm-frontal precipitation.



Steam fog or "sea smoke" a familiar sight to any seafarer.

• *Ice Fog.* Ice fog forms in moist air during extremely cold, calm conditions. The tiny ice crystals composing it are often called needles or spicules, and when the sun shines on these suspended particles, very bright reflections or shimmering lights result. Effective visibility is dependent largely upon whether or not one is looking toward the sun. Ice fog may be found as far south as the northern plains states but occurs mostly in the Arctic.

Sudden ice fog formation over an operationally significant area may be triggered by local sources of water vapor, condensation nuclei, or turbulence as might be induced by aircraft, automobiles, factories, launderies, etc. When the wind is very light and the temperature approximately 30°F or lower, ice fog often forms almost instantaneously in the exhaust of automobiles and aircraft. It sometimes lasts for days but its duration may be as short as a few minutes.

The *dewpoint* is that temperature, at a given pressure, to which air must be cooled to become saturated. When this temperature is below freezing, it is sometimes called the "frostpoint." The difference between the actual air temperature and the dewpoint temperature is an indication of how close the air is to saturation. This temperature difference is commonly called the "spread." Relative humidity increases as the temperature spread decreases and is 100 percent when the spread is 0°F.

The dewpoint is included in weather reports because it is a critical temperature, indicating the behavior of water in the atmosphere. When the surface air temperature is higher than the dewpoint, and the difference between the temperatures is increasing, any existing fog and low clouds are likely to dissipate because the air is becoming capable of holding more water vapor. This is especially true in the morning hours when air temperature near the ground is increasing. On the other hand, pilots should be alert for the possibility of fog or low cloud formation at any time when the surface air temperature is within 4°F of the dewpoint and the spread between the two is decreasing.

Summary

Fog has figured in a substantial number of aviation accidents in the past and has the potential to cause accidents in the future, ***unless it is carefully considered and accorded due respect in flight planning.*** Whenever there is reason to suspect that fog will be a factor during any flight, it will pay to discuss the matter very thoroughly with your friendly weatherman. Don't be caught in a fog bank . . .

Illustrations and weather data for this article have been excerpted from "Aviation Weather," a joint publication of FAA and the Dept. of Commerce.

The Survey Team

A Few Thoughts

By PRCM G. C. Kikos, USN

WELL, here we are again, tooling around at 16 thou on our way to another safety survey. What was it we were told during the briefing for that first survey? *Always call it a survey – not an inspection!* Pretty logical though. Seems like every time an outfit turns around they're having an AdMat or some kind of inspection. And of course, no matter what it appears to be, what we do is just review ordinary operating procedures for a few days, then tell the squadron, or station, the mistakes that are being made and in some cases point out areas where safe operating procedures are being compromised. I guess you could call it a safety review. Yeah, that even sounds better than survey. Heck, we just see things that are obvious, like dirty jars for taking fuel samples, no tool accountability system or maybe that the aircrews are a little lax in wearing (or not wearing) the proper protective equipment. I guess when you're so close to a problem it's pretty easy to miss it or just overlook it. Besides, when a squadron's given a tough mission or extra long, hard working days, it's easy for little maintenance errors to be made and soon they just seem to pile up.

Let's see, this makes about six surveys I've been on so far this year. Brother, if this keeps up they'll have to change the billet to sea duty. My bride says I'm on the road more than I'm home.

Boy, just look at that scenery from up here. You'd think that after all these years a person would get used to that sight. Beautiful, just beautiful . . .

Let's see now, where was I? Oh yeah, the safety critique. I hope the team boss can convince everyone that this is strictly a safety review and not an inspection. The findings go only to the command being reviewed and not another soul sees them. Some of the outfits being surveyed really get torqued out of shape. Who knows though, if I were in their shoes I might react the same way if some outside desk jockey pounced on me, especially if I figured I was doing a pretty darn good job.

What was that little ditty I read a while back in that Air Force magazine about safety reviews? It was right catchy. If I change it around a tad and use Navy terminology, I could probably use it. Let's see, it would go something like . . .

Nobody loves the Survey Team
When they come snoopin' round:
They write reports that upset folks
From the front office right on down.

Imagine the embarrassment
The CO felt, to hear
That one of his top flying types
Forgot to drop the gear.

The Maintenance Officer tore his hair
On reading all the flops
Reported by the Survey Team
When they went through his shops.

The Assistant MO was next
To note, with deep chagrin,
That an awful lot of static grounds
Would have to be put in.

The Line Chief with his towing rigs
Was sure that he'd be fired.
A check turned up six drivers there
Whose license had expired.

Av Equip did not escape
The Survey's prying eye;
Many pilots were jury-rigged
As they went out to fly.

The writeup on the Ordnance Shop
Was poor, as you can see,
The MERs and TERs were lying 'round
Like common F-O-D.

Powerplants and Airframes, too
Did not escape the chop,
Some mighty odd procedures
Were found within their shops.

QA's face is really red,
They'll never live it down –
When certain pubs were asked for . . .
They just could not be found.

The crowning blow came at critique,
Although there were some cheers,
When Survey Team Chief grabbed the mike –
And sparks shot from his ears.

At last the team all packed their bags,
Departure was their aim.
The CO said (with fingers crossed),
"We're *awfully* glad you came."

And so another survey ends;
It was a fruitful trip.
A lot of things were brought to light
That someone had let slip.

They call the team a lot of names
And claim that they've been had;
"Our outfit's on the ball," they say,
"We're really not that bad."

But hold it, Jack, just don't forget
Who safety will protect:
It's *you* my friend, your neck's involved
In hazards they detect.

You are the one who could be on
That plane which fails in flight.
It could be *you* who punches out
One dark and dreary night.

Whose toe's at stake when *you* refuse
To wear a safety shoe?
Who slips and falls on oily stands?
It's *you*, my friend, it's *you*!

It's also *you* who can correct
These hazards that exist.
The Safety Team won't find a gig
Unless it's one *you've* missed.

So take time to consider, friend,
If you were on the ball –
There'd be no need for Survey Teams,
They'd have no job at all.

And so, my friend, for safety's sake
Before you gripe and moan,
Clean up the gigs, the life you save
Might be *your very own*! *

Not bad, not bad at all. I wonder what guy first dreamed that little jewel up? You've got to hand it to him. Some people really have a way with the old king's English.

Doggone, this sure is a long, tedious flight. Sure wish they'd get us faster transportation. Thirteen hours flying time one way is about to get me (and 13 long hours back home).

Oh well, it all counts on 30. Maybe I can catch a few winks in the meantime.

** Adapted from "5AF Safety News"*

Aircraft Structural Fatigue Life Program

Illus 42-45

A FLIGHT of two fighter aircraft arcs across the sky. Soon the two aircraft separate and go at each other with each pilot intent on gaining a tactical advantage. The mock battle continues with each pilot maneuvering his aircraft to the edge of its operating envelope time after time. Before the hassle ends, they perform every tactical maneuver in the book. Eventually, one pilot gains the advantage and gets into a "firing position." The flight leader then signals his wingman to break it off; join up and head for home – training mission completed.

Thus ends a flight which is typical of hundreds which take place daily throughout the confines of naval aviation. The pilots are tired, but with sufficient rest and recreation they'll overcome their fatigue and soon be in as good a condition as ever. But what about the aircraft? Are they tired, too? Yes, they certainly are. They're tired in the sense that the high-G maneuvers just completed have produced a certain amount of fatigue in the metals which make up the aircraft airframes. But, unlike the pilots, no amount of rest will erase the fatigue which the aircraft have experienced. Airframe fatigue is permanent and the effects of airframe stress are cumulative. This means that every airplane has a finite "structural fatigue life" which can be denoted more or less exactly in terms of the degree and frequency of stresses which are applied to the airplane.

Nearly every model of aircraft in the inventory has been tested to determine its fatigue life or to determine compliance with military specifications which specify a required fatigue life. One or more representative aircraft are fatigue tested in order to verify how many times they can withstand actual test loads. Figure 1 illustrates a typical full-scale laboratory fatigue test set-up for a TF-9J aircraft. Thus, by considering the design of the aircraft and the fatigue test results, it is possible to determine the nominal or expected service life of any particular model aircraft based on the test spectrum of loads. Of course, slight differences in manufacturing methods and processes will cause variations (hopefully slight) in the strength of materials – and the structural fatigue life of individual airplanes. Nevertheless, the actual fatigue life of an airplane can be predicted with reasonable accuracy.

Depletion of Structural Fatigue Life

Every time stress is placed on an airplane airframe, a little of that airplane's structural fatigue life is depleted. Eventually, the entire fatigue life of the aircraft may be depleted. If the airplane continued to fly and continued to have stress placed on its airframe, the airframe would, predictably, fail catastrophically. This sad ending is to be avoided at all costs. But how? Appearances are deceiving. In many cases an aircraft which has 90 percent of its structural fatigue life expended may *appear* to be in as good or better condition as one which has only 10 percent of its life expended. Therefore, it is not the external appearance of the airplane which is important but, rather, the actual condition of the strength members of the basic airframe.

How about the calendar age of an airplane? Is this a good indicator of the amount of structural fatigue life which has been expended? The answer is a qualified

A TF-9J undergoes fatigue testing.
Fig. 1

"No." Assuming that the aircraft has been properly maintained with proper lubrication and corrosion control procedures followed, the calendar age of the aircraft provides only an indirect (and inexact) indicator of the stresses which have been placed on the airframe.

Actual flight hours are a better indicator of the stresses which the airplane has experienced but still are not the best indicator. The best indicator of all is an actual record of the stresses to which each individual aircraft is subjected. The mind may boggle at the thought of attempting to keep track of all the G forces each airplane experiences during every loop, hard turn or

other high-G maneuver throughout its life, but that, basically, is what NAVAIRSYSCOM has undertaken to do – and is now doing.

NAVAIRSYSCOM Counting Accelerometer Program

In FY-70, the Airframes Division of NAVAIRSYSCOM initiated the Counting Accelerometer Program at NADC (Naval Air Development Center), Warminster, Pa. This program provides for the collection and analysis of data on individual aircraft on a fleet-wide basis, and feedback of this data to aviation managers in the form of periodic reports. One of the basic elements of the data fed back is a determination of the percent of the structural fatigue life expended for each individual aircraft. It is important to note, however, that this figure *is not an exact expression of the actual percentage of structural fatigue life expended*. That is, an airplane which is reported by NADC as having 100 percent of its structural fatigue life expended is *not* expected to experience a catastrophic airframe failure on its next flight . . . or two . . . or three. This is so because NADC, using the most scientific means available for analyzing data, arrives at an in-house figure for the percentage of fatigue life expended *and then doubles this figure in its reports as a safety factor*. However, planned usage for aircraft beyond the reported 100 percent will require some sort of maintenance action. This could be the addition of reinforcements, replacement of components or perhaps retirement.

The basic elements of the NAVAIRSYSCOM program are:

- Data collection.
- Data analysis.
- Data output (reports).
- Data application.

Data Collection

The heart of the aircraft fatigue life program is a fleet-wide counting accelerometer program (refer to NAVAIRINST 13920.1A). Under this program, counting accelerometers have been installed in more than 3000 aircraft. Ultimately, counting accelerometers will be installed in every aircraft in the fleet except transport and rotary wing types. There are currently three types of counting accelerometer systems: the Maxson, Conrac (Giannini), and Systron-Donner. The parts of any installed system must be matched, i.e., a Maxson indicator must be installed with a Maxson transducer, etc. Generally, all three systems provide the same information . . . a record of times G-loads have been exceeded at four previously set positive G-load levels.

A typical counting accelerometer group includes two units (Fig. 2): 1) a transducer unit which is mounted near the center of gravity of the airplane and senses vertical accelerations imposed on the airplane and 2) the indicator unit which contains four counters and records the number of times four different preset acceleration levels have been equalled or exceeded as sensed by the transducer.

Counting accelerometer data is reported on NAVAIR form 13920/1 (11-69) by aircraft reporting custodians, naval air rework facilities and naval plant representatives on a monthly or situation basis, as follows:

- *Monthly:* Monthly reports cover the period from 0001 of the first day of the month through 2400 of the last day of the month that the aircraft was in custody of the reporting activity.
- *Situation:* Reports are submitted after occurrence of any of the following:

(1) Original installation of accelerometer group in aircraft.

(2) Removal of accelerometer group, indicator or transducer from the aircraft for any cause.

(3) Reinstallation of accelerometer group, indicator or transducer following removal for any cause.

(4) Transfer of aircraft, including temporary transfers to NAVAIREWORKFACs for PAR, repair or overhaul. (This report is made by the transferring custodian.)

(5) Aircraft stricken from the active list.

Data Analysis

When counting accelerometer report data is received at NADC Warminster, it is edited, keypunched, reduced by computer, integrated with fatigue damage theory and computer analyzed. For aircraft with less than 100 percent acceptable counting accelerometer data, a

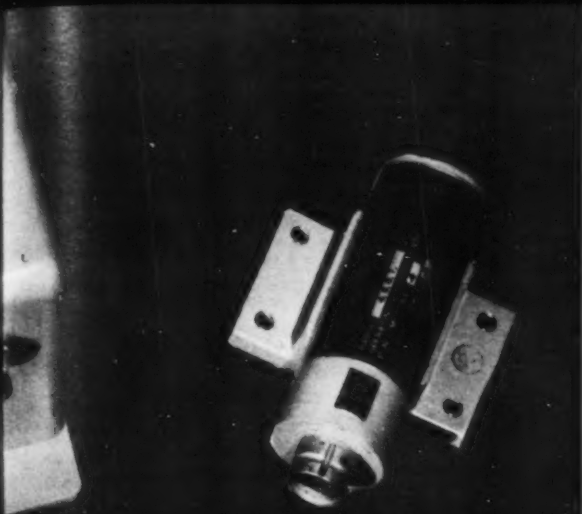


Fig. 2
A typical counting accelerometer installation. Indicator unit (left) and transducer unit (right).

statistical procedure is used to estimate how the aircraft was flown during the periods when data was not recorded. This statistical estimate is based on data received from similar aircraft in similar environments (e.g., combat versus noncombat). Much more could be said on the subject of analysis but suffice it to say that NADC, using the most scientific means available, reduces the data on each aircraft to a comparison between the actual fatigue usage of the airplane in flight with test usage in the laboratory.

Data Output

The basic data output of the program is a "Quarterly Structural Fatigue Life Program Report" (Fig. 3). This report is provided to type commanders, maintenance activities and plans offices and is tailored to provide:

- Fatigue data on each individual aircraft under the cognizance of the recipient of the report.
- Navy-wide model summary data for each model aircraft under the cognizance of the recipient of the report.

Data Application

The data generated by this program when combined with original design criteria, full-scale and component fatigue tests and other related factors serve as inputs for:

- Existing or planned changes of significance in fleet operations, including such factors as aircraft rotation, mission assignments or aircraft retirement.
- Solution to specific problems or failures of a structural nature having an immediate or projected impact on existing aircraft maintenance schedules, flight safety, PAR (progressive aircraft rework) and ARP (analytical rework programs).
- Engineering actions of a structural nature affecting the current or projected operational readiness and aircraft availability of fleet aircraft.
- SLEP (service life extention programs).
- Use in the design and test specifications of the next generation of Navy aircraft.

Summary

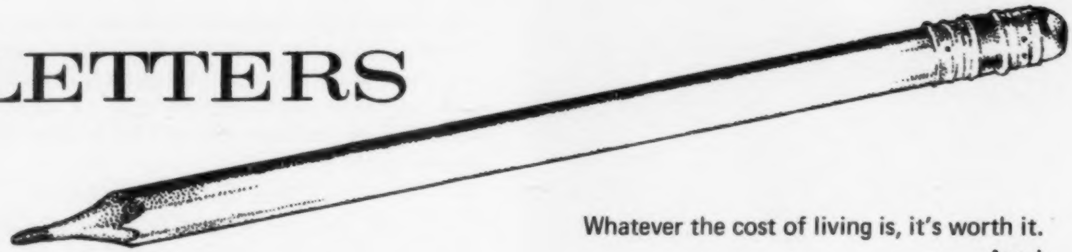
The NAVAIRSYSCOM counting accelerometer program has only been operating two years and is still in the process of growth and development. Nevertheless, the program is already producing highly useful data. At the least the data greatly enhance the safety of naval air operations through predicting "life cycles" of operational aircraft. At the most, it provides maintenance and industrial managers a valuable tool with which to insure the utmost in aircraft reliability.

DATA USES

- ***a/c rotation reassignment retirement***
- ***structural modification and repairs***
- ***establishment of maintenance schedules***
- ***life extension program***
- ***structural design criteria***
- ***projected fleet a/c requirements***

Fig. 3

LETTERS



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SV-2A Survival Vest

MCAS Cherry Point, N.C. – After recently completing a SEA tour cut short by my squadron's withdrawal, I would like to address the already horse-whipped subject of the SV-2A survival vest. Although my tour at DaNang was short, I flew sufficient missions to learn what a difficult task "surviving" with the SV-2A from day to day can be. As squadron flight equipment officer, I found the consensus to be that this vest was best designed to hasten heatstroke should one face a survival situation in the local climate.

Often, while waddling to my aircraft and scaling the boarding ladder to teeter over the canopy rail, I envision myself as being dressed in medieval armor waiting to be flipped on my back to fry in the sun like a tortoise. How great to feel my CG moved well forward by the weight of two required survival radios located in the front pouches and my sides quilted with a thick layer of jury-rigged rappeling line. I'm sure the end of that line was tied in a hangman's knot.

Considering mission effectiveness, I wonder how many bombs would have been a hundred yards closer to target, how many birds would have been on station five minutes longer or how many more photos centered on target without the discomfort created by the "octopus" in an already smoldering cockpit. And the SV-2A does spend about 99.99 percent of the time in the cockpit, as opposed to on-the-deck time in a survival situation. (Of course, I do not advocate elimination of a survival vest altogether.)

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Who Is Next?

The CO, in his endorsement of the incident, had a lot to say. Follow along and see how closely you guessed just what took place and why it happened.

"The time and date pinpoints . . . that this was a Monday morning launch – with the usual after-weekend spirit prevailing.

". . . but morning quarters and XO's personnel inspection delayed the usual routine.

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"Deviation from NATOPS. No checklists were used. The roller checklist is installed on the left-hand console shield and the copilot was in the right seat and did not use his PCL.

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Prior to development of the SV-2, aircrews were using a variety of locally manufactured survival vests to carry everything from machetes to hammocks. (See "You, Too, Can Be a 97-Pound Heavyweight," APPROACH, January 1967.) However, the thinking on the amount and type of survival equipment has recently changed. NAVAIRSYSCOM has responded to the new trend through NAVAIRDEVCEN (Naval Air Development Center) by coming up with a revised list of what should be carried by pilots and aircrewmen by type aircraft. This revised list was published by CNO letter OP-506N, Ser 6172P50 of 28 June 1971. Implementation of the list should reduce the bulk of the SV-2A considerably. Future plans may reflect deletion of the requirement for the SV-2A in certain type aircraft.

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NAVAIRDEVCEN is currently looking at the whole survival vest program. We will keep you posted on developments.

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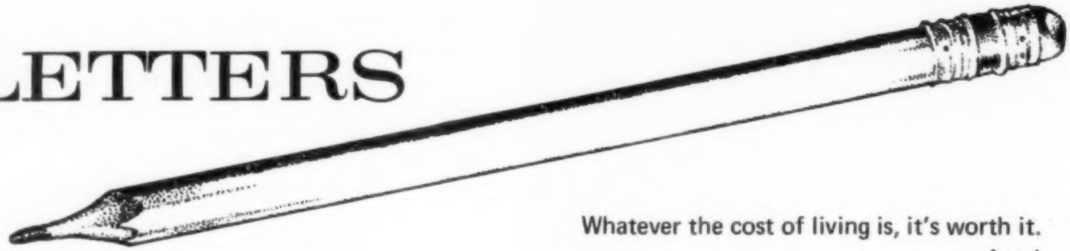
LETTERS



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CAPT W. E. Simmons
Commander, Naval Safety Center

Our product is safety, our process is education and our profit is measured in the preservation of lives and equipment and increased mission readiness.

Contents

48

Departments

NavAir 00-75-510

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Credits

Cargo on the move is our cover theme this month as staff artist Blake Rader depicts a flight of CH-53s making a special delivery to the fleet. Pg 31 Photo by Leota Jane Harmon.

WATCH YOUR ATTITUDE!

The very first time man flew from a carrier,
In those earliest years, was he safer and warier?
Or was he more reckless and devil-may-care?
We can only find out from those who were there.

You see, in those days there was no NAVSAFECEN
To keep track of mishaps, the how, why and when.
So of accident rates in that time we can't say,
Though we can and we do know the rates for today.
There's no long-term info on accident tolls,
To tell us if we've been achieving our goals.

We've seen the old movies with Wayne, Grant and Cooper,
And we know that the early tailhookers flew super.
But in trying to view the historical track,
Some questions arise as we start looking back.

Attempts to compare yesteryear's accidents
With those of today really don't make much sense.
Hardware and equipment of every description
Have evolved to a point that defies recognition.
Aircraft are bigger, fly higher and faster,
Missions and ops are incomparably vaster.

In so many areas nothing's the same,
That it might be considered a brand new ball game.
But one thing that hasn't changed much from before,
Aviators today are quite like those of yore.

They're taller and heavier from better nutrition
(Though there may be some question
'bout physical condition).
The flight surgeons say that they're probably healthier,
And, despite the inflation, they seem to be wealthier.
But changes in health, fiscal status and size,
Just may not be relevant facts safety-wise.

And though it may seem like we're talking in platitudes,
We'd like to know about changes in attitudes.
In studying safety improvements we can
Measure the machines with more ease than the man.

And somehow it's easier to know what to do
When the problem is hardware instead of the crew.
In short then the problem, it seems, is just that
The man in the system is where it's all at.
*(The foregoing statements include those who fix
Just as much as the fellows who handle the sticks.)*

So this is where attitude changes come in.
To reduce people errors that's where you begin.
And a program that's solid and firm as Gibraltar,
That bringeth no changes is foredoomed to falter.
Though all of its points are basically sound,
No changes – no chance for it to get off the ground.

Well, as we were asking before our digression,
Have attitudes changed o'er the years? was the question.
We don't know. If they haven't, it's time that they did.
Aviation's too old to behave like a kid.
Just as adults put away childish things,
Maturity's needed to go with the wings.

And along with maturity go (we would pray)
Some questions about how we do things today.
Though stressing our point once again may be crude.
Both aircraft and men need the right attitude.

LT Norman E. Lane, MSC, USN

Idea contributed by VAQ 130, Det 4

REUSABLE CONTAINER DO NOT DESTROY